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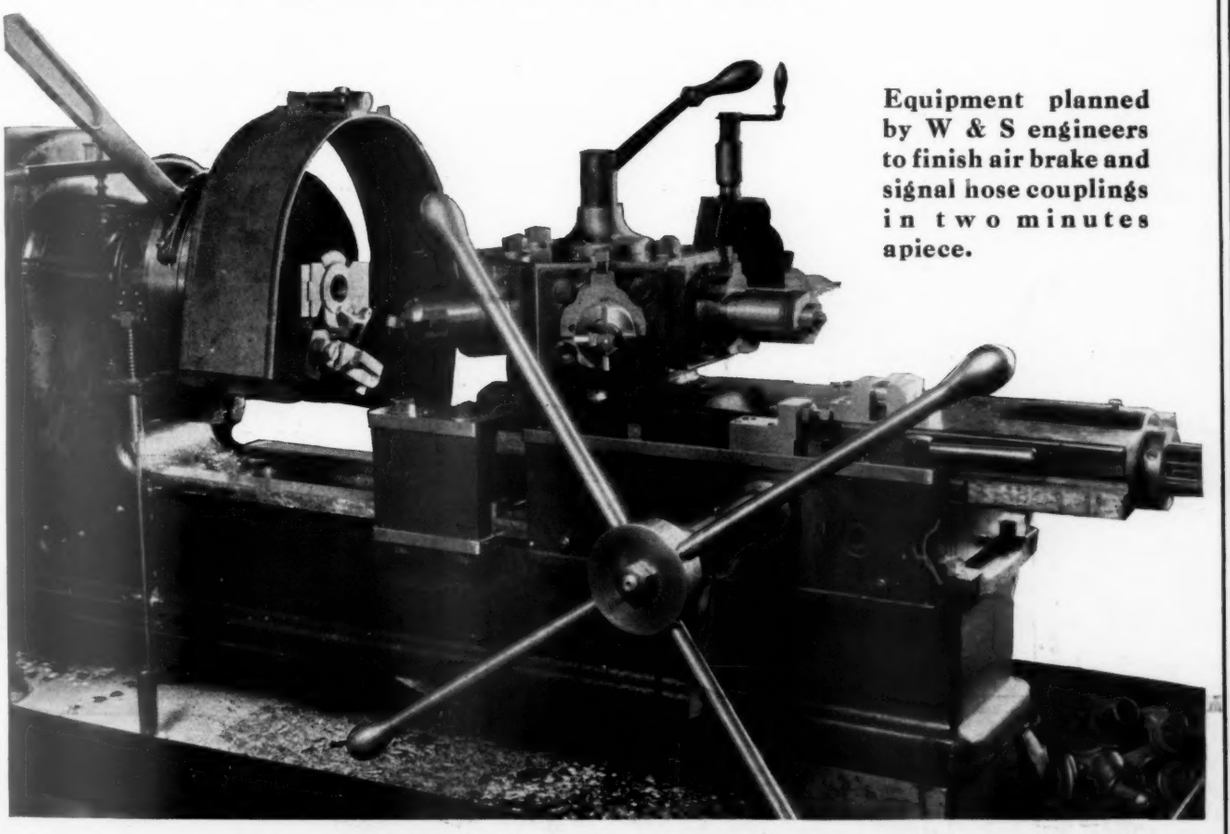

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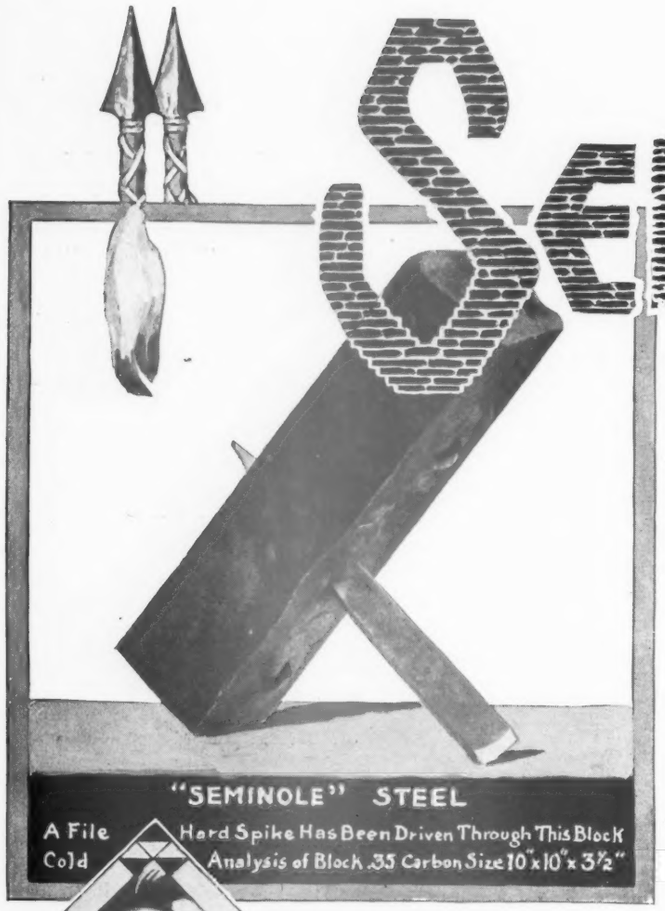

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Railway Mechanical Engineer

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The Planer Type Milling Machine

An article in this issue describing the machine operations performed on a four-head, planer type milling machine, recently installed in the Beech Grove shops of the Big Four, will be read with interest by railroad machine shop men. While this type of machine has demonstrated its value before in railroad shops, it has by no means come into the general use that would seem warranted by the production secured. For the quantity machining of certain locomotive and car parts, no more productive tool can be used. The article in question shows how locomotive driving boxes and crossheads are machined on this miller in one-third to one-quarter of the time formerly required on a planer. This does not mean that the milling machine is always more effective than the planer because, for many operations, the planer is the more adaptable tool. Also, when single parts are to be machined, the time required to set up and perform the operation on a planer is less than when setting up the work on a milling machine and getting milling cutters of the required shape and size to perform the work. For the quantity production of many duplicate parts, however, the milling machine cannot be equaled.

Three important advantages of the planer type milling machine are the large proportion of total power used in removing metal, a cutting operation which is continuous, and the reduction in time required for tool setting and grinding. It is obvious that with a considerable number of cutting edges working at the same time the milling cutter can remove metal much faster than any tool having but a single cutting edge and experience has demonstrated that milling machine work possesses the advantages of both accuracy and high production. There seems little question that one way to increase the productive capacity of many medium and large sized railroad shops would be by the more general use of planer type milling machines to perform duplicate machine operations on locomotive and car parts.

Production Machine Forging

In most railroad repair shops the blacksmith departments occupy a less important position than formerly, due to the greatly increased use of the autogenous cutting and welding process. In one line of endeavor, however, the blacksmith shop is more than holding its own and that is in the quantity production of locomotive and car parts, made on forging machines. In fact, the general impression gained by visiting a modern railroad blacksmith shop is that the most efficient production methods have been developed in machine forging work. Bolts are being made in great numbers and all sizes. Truck cross-ties, draft sills, reinforcement channels, drawbar yokes, air brake levers and rods, and literally hundreds of small parts for use on locomotives and cars, are being produced in quantity by efficient forging machines at a reasonable cost. The quality of this work is excellent and its cost compares favorably with that of other methods of manufacture. Elsewhere in this issue is an article on machine forging practice at the Elizabethport shops of the Central of New Jersey in which four typical forging machine operations are described in detail, showing the dies used and the sequence of operations. This article will be of interest to

railroad men employed in blacksmith shops and others concerned in the production secured with forging machines. Oftentimes great mechanical ingenuity and knowledge of the flow of metal under pressure is displayed in the design of forging machine dies and railroad men deserve much credit for the present development of this art. More or less complicated parts are made at a single blow and, taken all together, almost no part of railroad blacksmith shop work exceeds, either in interest or value, that done on forging machines.

Specialized Training vs. Apprenticeship

In discussing apprenticeship, a shop superintendent stated recently that he was disappointed because so few satisfactory apprentices could be induced to enter the course. The majority of applicants were foreigners, who proved very slow to learn and would have been rejected except for the fact that competent mechanics were badly needed and it was desirable to train as many as possible. This is not an unusual condition. It will be remembered that a survey made by the Railroad Administration showed a very low ratio of apprentices to mechanics throughout the country. There is still a demand for men with all-round training and always will be, for it is from this class that foremen should be recruited. On the other hand, if the apprentice course cannot supply the required number of skilled mechanics some other means, such as part-time instruction, should be provided for training promising employees in order to develop efficient workers in each special field. Would not the benefits obtained in increased output and the flexibility of the organization justify the small expenditure necessary to carry out such a plan?

Air Area Through Grates and Ash Pans

It is unfortunately a very common characteristic of human nature to place small value upon, and to give scant consideration to, those things that are common and cost but little money or effort to obtain, while those which are expensive are highly prized. With the steadily mounting costs of fuel there is an increasing attention being given to the subject of economies in its use and much is said and written on fuel conservation. In considering the design of locomotives for economical operation, careful consideration is given to the grate area, the firebox, the arrangement of heating surfaces and the probable savings which might result from the adoption of various devices. These points are of prime importance and are worthy of even more consideration than they oftentimes receive. However, the fact that coal cannot be burned without an adequate supply of oxygen must not be overlooked. Although it is not necessary to purchase air, provision must be made for its access to the fuel bed. This means that there must be openings of a proper size through the grates and through the ash pan.

As an illustration of the air requirements, consider a modern Mikado freight locomotive having 70 sq. ft. of grate area in which the attempt is made to burn coal of 12,000 B. t. u. heating capacity at the rate of 120 lb. per sq. ft. of grate per hour. This is equivalent to 2 1/3 lb. of coal per sec. and as it is necessary to furnish approximately one pound of air for every 1,000 B. t. u. in a pound of coal, this means an air supply of 28 lb., or 368 cu. ft. per sec. at a temperature of 62 deg. F. While it may be possible to draw sufficient air into the firebox at moderate rates of combustion, at the higher rates the supply is frequently decidedly inadequate and this becomes the controlling factor when forcing locomotives to their maximum capacity. The design and proportions of grates and ash pans are too frequently left to any draftsman who can make slight changes in dimensions of older drawings to fit such details to the size of the firebox and provide the necessary clearances. Instead of considering this as a subject of minor importance and entrusting it to a man who knows only partially what he is doing, the air inlet proportions should have the consideration of the best informed engineer.

Length of Tubes and Combustion Chambers

Experimental data have conclusively shown that the gain in evaporation obtained by increasing the length of the tubes beyond a certain amount is by no means proportional to the increase in the amount of heating surface. For example, an increase in the length of 2¼-in. tubes from 20 ft. to 25 ft. adds only about 5 per cent to their evaporative capacity despite the fact that their heating surface is increased 25 per cent. For additional increase in length the gain in evaporative capacity is even proportionately less. In a boiler having 2¼-in. tubes, 25 ft. long, the evaporation taking place from the last 2 ft. next to the smokebox is only about 10 per cent as much as from the first 2 ft. next to the firebox. For the best results the length of the tubes should not be more than 120 times the inside diameter, or about 20 ft. for tubes of 2¼ in. outside diameter. With tubes of this length there will be sufficient space for an ample combustion chamber in all boilers of long wheel-base locomotives. The value of the more complete combustion and the better mingling of the gases before they enter the tubes, and also the high value of the evaporative surfaces of a combustion chamber which are obtained from the use of this valuable extension of the firebox volume are quite generally recognized today.

These points were unfortunately not as well known a few years ago and as a result many comparatively modern locomotives have boilers in which the tubes are longer than they should be. In such cases when extensive overhauling, including considerable boiler work, becomes necessary, it would be wise to consider whether the expense involved in shortening the tubes and adding to the length of the combustion chamber would not so increase the steaming capacity and reduce the fuel consumption as to render probable a large return on the money expended in making the changes.

Aluminum Parts for Locomotives

Ordinary aluminum has been used very little in engineering work. The lightness of the metal is a great advantage for certain purposes, but this is outweighed by the low strength and small ductility. Aluminum weighs about one-third as much as steel and has about one-third the strength of mild steel so that parts designed to resist equal tensile stresses would weigh about the same whether made of aluminum or steel. During the war, investigators in England devoted considerable attention to experiments with aluminum alloys. Some remarkable results were achieved, the details of which have recently been made public. It was found that the characteristics of aluminum are affected to a marked degree by the addition of small amounts of other metals. By changing the amounts of alloying elements added, material has been produced that is little heavier than aluminum and as strong as mild steel and with equal fatigue resisting properties.

One of the aluminum alloys which is suitable for use at ordinary temperatures consists of aluminum with about 13 per cent of zinc and 2½ to 3 per cent of copper. The tensile strength of this alloy is 44,000 lb., the elongation 4 per cent in two inches and the density 3.0. The aluminum-zinc alloys show a considerable decrease in strength as temperature increases, but special compositions have been developed to overcome this tendency. An alloy of aluminum with 4 per cent of copper, 2 per cent of nickel and 1½ per cent of

magnesium shows a tensile strength of 52,000 lb. per square inch at normal temperature, which decreases only to 44,000 lb. at 250 deg. C. (482 deg. F.). This material can be forged or rolled.

The work completed up to this time probably marks only the beginning of the development of aluminum alloys, but even so it may open new possibilities in the design of locomotives; for example, if the weight of crossheads and pistons could be reduced one-third by the use of these metals, the problem of counterbalancing would no longer be so troublesome. Relative cost is, of course, a factor that must be considered and parts made of aluminum alloys, in spite of their light weight, would be several times as expensive as steel. However, where the weights of the reciprocating parts are a serious factor, the application of aluminum alloys may prove to be justified.

Save Labor in Refitting Hose

One of the most familiar operations in the air brake departments, especially of car repair shops, is the dismantling and assembling of air brake hose. On the locomotive side, signal and steam heat hose also have to be refitted as fast as the hose become worn out or defective. At certain small points practically all dismantling and refitting is done by hand and, where the number of hose involved is small, this method is probably entirely satisfactory. At other points, home-made devices of various sorts have been devised and used with more or less success. At large shops, however, where the number of hose to be dismantled and refitted often amounts to several hundred or even thousands each month, it is obviously poor economy to do the work by hand or with inefficient, home-made devices.

For the purpose of dismantling and assembling air, signal and steam heat hose, a special machine has been developed with a view to combining the desirable features of ease of operation and high production. It is said that with this machine one operator can cut the clamp bolts on 140 hose in 20 min., dismantle these hose in 40 min., and reassemble new hose complete, applying clamp bolts and nuts at the rate of 30 hose ready for service, in 60 min. With such a production the machine should have no difficulty in paying a considerable return above interest and depreciation charges and prove a profitable investment in any railroad shop faced with the problem of dismantling and assembling large numbers of air, signal and steam heat hose.

Don't Neglect the Power House

The power house is generally recognized as a vital part of every shop plant. Practically every important operation is dependent on this source of energy. Placed out of the way, often some distance from other shop buildings, the power house is likely to receive only casual attention from the shop executive so long as everything runs smoothly. Unless the entire equipment in the plant and throughout the shops is carefully watched, a gradual decrease in efficiency and an increase in wasted power is certain to occur. Some day when the shop is being worked to its full capacity, it is found that the boilers cannot supply the demand for power. The general foreman is concerned primarily with shop output. When he finds output hampered by the power house, he is anxious to correct the condition at once and is very likely to do it in the most direct and obvious way—by adding to the capacity of the boiler plant.

Probably the majority of shop foremen would resent the suggestion that they do not give the proper attention to the power house. It is true that in making the rounds of the plant they see the engineer and make sure that the plant is meeting demands and that there is no danger of shutting down. The need for reliability in the power house is recognized, but economy in the production of power unfortunately seems to receive only spasmodic attention and wasteful conditions may continue for a long time without being detected, as the following incident shows.

At a certain large railroad shop it became necessary to allocate the cost of power to various departments. To do this the coal used was weighed, an average value for evaporation was assumed, and the steam was apportioned on the basis of the theoretical consumption of the various engines, compressors and pumps. The result did not check with the measured power output and study showed that the actual efficiencies of both boilers and prime movers were far lower than what should have been obtained. The entire plant was later overhauled to correct the wasteful condition.

The cost of producing power is a considerable item in any shop and economy in fuel should be given close attention. It is interesting to note the opinion of a recognized authority on boiler plant efficiency, who recently stated that a large majority of plants possess and operate too many boilers, often twice as many as necessary. When conditions seem to demand additional boilers, it is always advisable to look carefully into the efficiency of those already in use. Power houses as a rule have a large overload capacity and additions to the boiler plant should not be necessary except when other shop facilities are enlarged.

Comprehensive Electrification Again Proposed

During the past two years a staff of engineers has been engaged in investigating the possible economies that might be effected by a comprehensive system for the generation and distribution of electrical energy in the North Atlantic states. The work was initiated and directed by W. S. Murray, formerly electrical engineer of the New York, New Haven & Hartford. One of the principal features of the proposed plan is the electrification of 19,000 miles of track at a cost estimated between $400,000,000 and $500,000,000. Despite this enormous capital expenditure a saving of 14 per cent on the investment is claimed for this so-called superpower system.

This is not the first time that such statements have been made with regard to comprehensive schemes for electrification. Nevertheless the investigation of specific cases has shown that the savings claimed could not be realized in practice and that the economies resulting from electric operation were not sufficient to warrant the large investment necessary except under very special conditions. The present plan is unique in proposing an interconnected system of steam and hydro-electric power plants to serve the railroads and industries. By this method it is claimed that one kilowatt hour could be delivered at the sub-station for the equivalent of two pounds of coal, or at a cost of one cent per kilowatt hour.

Assuming that the efficiency claimed for the superpower plants can be maintained, it is interesting to follow the reasoning by which the authors of the report reached the conclusion that the system would save nearly 60 per cent of the coal now used by the locomotives. The efficiency of the sub-station is assumed to be 85 per cent, the distribution 90 per cent, and of the electric locomotive 82.5 per cent. The output of the locomotive is therefore 63 per cent of the sub-station input, making the equivalent coal rate 3.18 lb. per kilowatt hour. The coal per kilowatt hour of the locomotive is assumed to be 7.5 lb., which makes the saving for the electric locomotive 57.6 per cent. This figure for locomotive coal consumption is altogether too high even for saturated steam engines, being almost identical with the value obtained under unfavorable conditions with saturated steam locomotives on the Chicago, Milwaukee & St. Paul. If the method used in computing the equivalent coal consumption

under electric operation is applied to the steam locomotive, the result is quite different. An efficient modern locomotive uses about 2.5 lb. of coal per horsepower hour output while working. Standby losses, firing up, etc., increase this to 3.09 lb. per horsepower hour, or 4.14 lb. per kilowatt hour. On this basis the saving by electrification would be only 23 per cent.

It is not feasible to discuss the other sections of the report at length. The example given above will serve to show that the authors did not take the trouble to inform themselves of the capability of the modern steam locomotive. Much of the information presented is valuable, but the report suffers from a manifest tendency to favor the electric locomotive and not do justice to the steam locomotive.

COMMUNICATIONS

Car Wheel Grinding Data Desired

Asuncion, Paraguay, South America.

To the Editor:

Our locomotive and car shops are equipped with a car wheel grinding machine, manufactured by Messrs. Miller & Co., Ltd., Edinburgh. The working velocities of the grinding wheels and chilled cast iron car wheels ground are 1400 and 14 r.p.m. respectively and it takes from seven to eight hours to grind a pair of wheels. The grinding wheels used are made by the Carborundum Company, Ltd., size 16 in. by 1½ in., grit 24, grade Hx, bond H.D., with a recommended operating speed of 1,194 r.p.m.

I read some time back in the *Railway Mechanical Engineer* (June, 1920, pages 356 and 357) that the average time should be 38 min. including setting up.

I shall be very much obliged if you will kindly let me have details of grinding wheels used during the tests tabulated by you in the article referred to. E. Thomas,

General Manager, Central Railway of Paraguay.

The writer of the above letter requests data regarding certain specific car wheel grinding tests, but would doubtless be glad to benefit by the experience of any American railroad man familiar with the practice of grinding chilled cast iron car wheels. Railroad men in this country should cooperate with each other and with fellow workers in foreign countries just as much as possible. Mr. Thomas would probably be interested to know the particulars of methods used in American railroad shops to increase the output on car wheel grinding and the *Railway Mechanical Engineer* will be glad to transmit to him data regarding the type of grinding machine used, number of wheels ground per hour, relative abrasive and car wheel speeds, depth of cut, and any other information found by our readers to provide greater car wheel grinding machine production.—Editor.

Comment on the Purchase of Machine Tools

El Paso, Texas.

To the Editor:

Your editorial in the October number of the *Railway Mechanical Engineer* on the purchase of machine tools was read with a great deal of interest, and I heartily concur in your statements.

One of the most common faults of a great many railroads is the purchase of shop machinery based on first cost with the disastrous result that in a short time the machine is either worn out, or the weak parts have failed, and if the machine is worth repairing, new parts of stronger and more rigid construction are of necessity made and applied.

A machine to meet the demands of the ordinary shop must be of heavy and rigid design, capable of withstanding rough usage and at the same time turn out work to precision. The machine must also be adapted to the work ordinarily required of it. It is a mistake to continue the use of antiquated, time-consuming machinery in the shop, occupying space that is at a premium, where a modern machine capable of turning out more accurate work at a much more rapid rate ought to be installed.

During the war, when delivery of material was uncertain and when prices were fluctuating, a quotation did not amount to much, especially where used for an estimate. However, even at the present time when prices appear to again be dropping to normal, requests for quotations should state the probable date when such quotations would be used. It is often difficult in working up a budget to judge just when a machine may be purchased, but it would be a good plan to so advise the manufacturer in order that he could quote accordingly.

As to the sending of a representative of the manufacturer to the railroad contemplating the purchase of machinery, ordinarily such a trip is unnecessary as the mechanical officials of a railroad know pretty well what their requirements are. Of course, where an entirely new installation is planned it no doubt would be advantageous to have a machine representative on the ground who has had experience in planning and locating machinery to the best advantage for handling material in the railroad shop. F. G. Lister,

Mechanical Engineer, El Paso & Southwestern.

NEW BOOKS

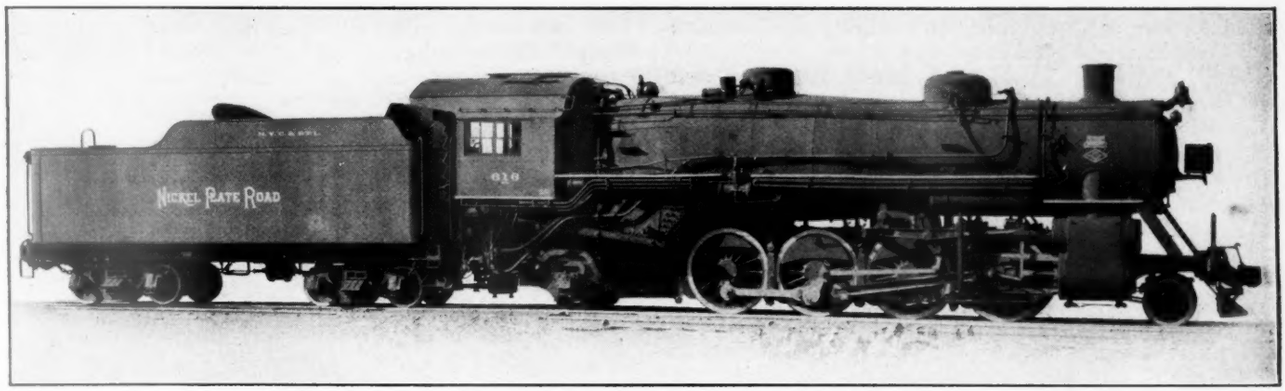
Air Brake Association Proceedings for 1921. *F. M. Nellis, secretary, 165 Broadway, New York. 200 pages, 6 in. by 9 in. Bound in cloth.*

In lieu of the twenty-ninth annual convention, which was postponed on account of railroad business conditions, the Executive Committee of the Air Brake Association held an open meeting at Chicago on May 3 and 4, 1921, at which time the necessary business of the association was transacted and the reports and papers presented in abstract only, discussion being postponed until next year's convention.

The proceedings of this meeting include the following reports and papers: Recommended Practice; Tests of Steam Heating Apparatus on Locomotives and Passenger Trains, Montreal Air Brake Club; Terminal Tests to Insure Effective as Well as Operative Brakes, Pittsburgh Air Brake Club; Schedule "UC" Brake Equipment; Brake Pipe Vent Valve, Central Air Brake Club; Air Consumption of Locomotive Auxiliary Devices; and Triple Valve Repairs, Northwest Air Brake Club. In addition to the committee reports and papers, the reports of the officers and a list of members are included.

Questions and Answers on the UC Equipment, 1921. *72 pages, 5 in. by 7 in. Published by the Air Brake Association, 165 Broadway, New York.*

The Air Brake Association has just added to its list of educational books, one on the Westinghouse UC equipment. The book is intended for those men engaged in railroad service who desire to inform themselves on the construction, operation and function of the new UC passenger air brake equipment. It is a radical departure from much air brake literature in that it does not necessitate an intimate acquaintanceship with ports and passages. The subject has been covered not only by a text, but also by questions and answers. For those readers who desire general information in a minimum of time, the first fifty questions and answers have been prepared. For readers of the class who prefer the regular descriptive form, a summary has been included. Those readers who seek a more exhaustive treatment of the subject may find it in the complete questions and answers.



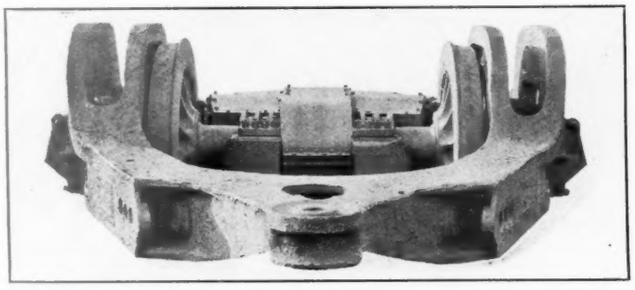
Mikado Locomotive Equipped with Booster

2-8-2 Type Locomotives for the Nickel Plate

Design Based on U.S.R.A. Light Mikado with Improvements in Details—Booster Handles 22 Per Cent Additional Tonnage

THE New York, Chicago & St. Louis (Nickel Plate) has lately received from the Lima Locomotive Works six Mikado (2-8-2 type) locomotives. The design was based largely upon the U.S.R.A. standard light Mikado, ten of which were allocated to the road, but a number of new and interesting features were added which make the locomotives among the best of this class.

One of the locomotives was equipped with a booster furnished by the Franklin Railway Supply Company and provision was made on the other engines for the ready application of boosters at some future time. The trailer trucks are of the Commonwealth Steel Company's outside bearing Delta type, equalized with the drivers. The booster and truck are shown in two of the illustrations.

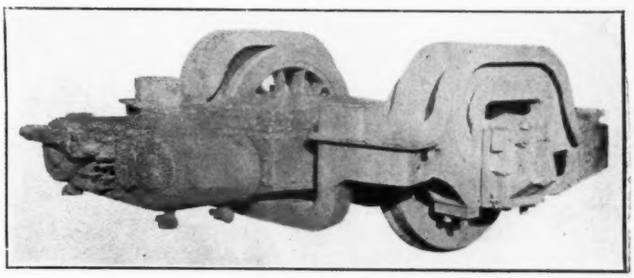


Front View of Trailing Truck with Booster

These locomotives have a tractive effort of 54,700 lb. without the booster and 64,200 lb. with the booster, an addition of 17 per cent. The cylinders are 26 in. by 30 in. and the drivers 63 in. outside diameter. The total weight of the locomotive equipped with the booster is 307,000 lb., of which 226,500 lb. are on the drivers, 20,500 lb. on the front truck and 60,000 lb. on the trailing truck. The driving wheel base is 16 ft. 9 in. and the total engine wheel base 36 ft. 1 in. The frames are fitted with a cast steel cradle and Franklin automatic adjustable wedges are used on all drivers. The valve gear is of the Walschaert type and control is by a Ragonnet type B power reverse. Cylinder and steam chest bushings are of Hunt-Spiller metal. The front truck is of the constant resistance type. Okadee automatic cylinder cocks and White single sanders to the front drivers only are among the other specialties. The front end main rod brasses are not adjustable but are provided with solid round bushings pressed in the same as on the side rods.

Instead of six-feed lubricators with feeds to the cylinders, these locomotives use four-feed lubricators, the cylinder feeds being omitted in accordance with the standard practice on the Nickel Plate which has been found to be entirely satisfactory.

The boiler is of the conical-connection type with combustion chamber and is equipped with type A top header superheater, Security brick arch and butterfly type firedoor. A Duplex stoker is used and particular attention was given to the cab arrangement to locate all necessary piping and fittings for the greatest convenience of the engineer and fireman. The boiler pressure is 200 lb. The firebox is 114⅛ in. long by 84¼ in. wide, which gives a grate area of 66.7 sq. ft. There are 216, 2¼ in. tubes and 40, 5½ in. flues, 19 ft. long. The heating surface of the firebox, combustion chamber and arch tubes is 280 sq. ft., the evaporative heating surface of the tubes and flues 3,497 sq. ft. and the superheating surface 882 sq. ft.



Side View of Trailing Truck with Booster

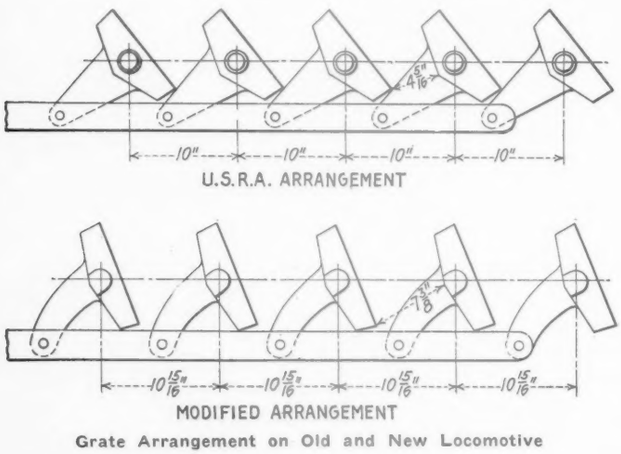
Special features include a cast steel ash pan, Woodard outside connected throttle with lever support designed to provide for expansion of the boiler, Nathan non-lifting injectors, Phillips top boiler check valves and Franklin power grate shaker.

The two center arch tube plugs in the throat sheet are located on the radius and in order to get good threads the holes in the sheet are tapped out 3½ in., steel bushings screwed in and then welded around the edge, the arch tube plugs being screwed into the bushings. This may be con-

sidered a minor detail but attention to such points can save much vexation in the roundhouse.

The grate arrangement is of an entirely different design from that used on the U.S.R.A. standard light Mikados. The U.S.R.A. box grate had a straight horn perpendicular to the grate on the longitudinal center line. With this arrangement when the grates are wide open the maximum distance between the top of one grate and the bottom of the next grate is 4 5/16 in. In redesigning the grate arrangement, a curved horn was used which threw the center of the grate connection pin about 3½ in. ahead of the center. When these grates are wide open there is a maximum of 7⅜ in. from the top of one grate to the bottom of the next. The difference in design is shown plainly in the illustration.

Drop grates were used on the U.S.R.A. locomotives, but these were omitted on the new Mikados which have 10 rocking grates on each side of the firebox. With the large openings it is possible to dump the fire much more quickly and easily than with the old standard arrangement of drop grates and smaller openings in the rocking grates. The curved horn grate is not original on the Nickel Plate for it is the standard on the New York Central. However, the comparison between the two designs is interesting, especially as it is in connection with such points as this that the U.S.R.A. standard designs commonly have been criticized.



Grate Arrangement on Old and New Locomotive

As indicative of the value of the booster the record of a run made soon after the locomotive was received is of interest. This run was between Conneaut and Buffalo with a train of 50 loaded cars, 3 empty cars and 2 cabooses, the tonnage being 3,848. The regular tonnage for this class of power without a booster is 3,136. The excess tonnage handled was thus 712, an increase of 22.7 per cent over the regular rating.

The train left Conneaut at 8:40 a. m. and arrived at Tift street yard, Buffalo, at 4:32 p. m. The time on the division was 7 hr. 52 min. and the actual running time 5 hr. 45 min., an average speed while running of 19.9 miles an hour.

The booster was used eight times, as follows: Leaving Conneaut yard; on Springfield hill; pulling into and out of Girard siding; pulling into Cascade siding; pulling into and out of Pomfret siding; starting at D. A. V. & P. crossing, Dunkirk, and on Delaware hill. The approximate distance over which the booster was operated was three miles.

The maximum steam pressure was maintained over the entire division—even when the booster was operated the steam pressure did not fall and it was not necessary to lower the water level. In ascending Springfield hill the speed slackened to about seven miles an hour. The booster was then cut in and the speed was accelerated to approximately ten miles an hour before the top of the grade was reached.

It was necessary to stop at the D. A. V. & P. crossing in Dunkirk. After the crossing was cleared the train, although standing on a heavy ascending grade combined with a slight curve, was started with the aid of the booster at the first attempt. This is considered one of the hardest places on the division to start a train, and demonstrated the added drawbar pull obtained from the booster.

Causes of the Present Bad Order Situation

In an article recently published in the *Railway Age*, J. E. Muhlfeld makes the following comments on the bad order situation:

Never have I seen freight cars generally in a more dilapidated condition, due to lack of proper upkeep. This situation is the result of several years of improper distribution, handling and use of cars, coupled with the making of costly repeated light repairs to keep them moving, whether loaded or empty, instead of making the ultimately less expensive substantial repairs, renewals and improvements at the time needed, to keep them in economical working order.

My observations have led me to believe that the freight car situation offers one of the most costly propositions that the railroads are up against, both from a capital and operating expense standpoint, and that the cause for this is the lack of proper upkeep and the misuse of equipment during the federal control period; the neglect of preservation and resulting deterioration of metal in the car bodies and underframes due to corrosion, and the damage to underframes and superstructures because of deficient and defective draft gear and attachments. This latter item is something that is giving all of the railroads a great deal of concern, as when, for example in all-steel equipment, the strength of the underframes is reduced through corrosion of the floor and other plates, if the cars are permitted to run without any cushioning resistance for the buffing and pulling shocks, it does not require much rough yard handling or heavy train service to destroy the center sill and underframe structure, more particularly between the body bolsters and end sills. The fact that cars have been permitted to run without proper draft gear renewals and maintenance during the federal control period, and which practice is being continued at the present time, is due largely to the re-establishment by the U. S. R. A., and by various representative railroads, of the long since discarded transverse key type of coupler and coupler yoke connection, which couples the coupler with the center sills and enables the running of cars without draft gear.

It can be readily understood what shocks the underframes of cars are subjected to, both buffing and pulling, when they are operated in this condition. Until the A. R. A. eliminates the use of such a device and restores the use of an arrangement which *couples the coupler to the draft gear only*, and requires the maintenance of the latter, the existing conditions will not only continue but become more aggravated. The use of the coupler center sill key attachment is also resulting in extraordinary damage to couplers. Even the latest A. R. A. heavy "D" type couplers have been found with not only various parts cracked and broken, but also with the shanks between the coupler head and the butt stoved up as much as from ⅝ in. to 1 in., due to extraordinary buffing shocks in combination with being run without draft gear in proper condition. Furthermore, the neglect to maintain draft gear and attachments, in combination with the many useless so-called "friction" types of draft gears that have been applied during the past 20 years, is responsible for much extraordinary center and end sill, draft arm and lug, body bolster, coupler and yoke damage.

The modern freight car with its increasing ton-miles per day's work, in longer and heavier trains, requires *actual* maintenance to keep it in serviceable condition and the issuance of instructions to reduce the number of cars in bad order condition so that they will not exceed 4 per cent of the total will never take the place of needed actual repair and renewal work on existing equipment.

Plan for Electrifying Sections of Eleven Railroads

Superpower Report Provides for Consolidation of Power Supply in Region Between Boston and Washington

A REPORT called the Superpower Survey was transmitted to the President on November 5 by Secretary of the Interior Fall. It is the result of an investigation of the possible economy of fuel, labor and material resulting from the use of a comprehensive system for generating and distributing electricity to transportation lines and industries. The investigation was made by a staff of engineers working under the direction of W. S. Murray, consulting engineer, New York; in preparing the report they have endeavored to show how the economies of a power system on so large a scale will affect not only coal, but capital expenditures as well, and especially the output of human energy.

The plan provides for the interconnection of a large number of existing plants in the area shown in several of the illustrations by high voltage transmission lines. These lines would include and be extended to other points at which large power plants could be located advantageously at the mouths of mines, at tidewater, or along rivers suitable for hydro-electric developments. It would be necessary to derive more than 80 per cent of the power from coal. The maximum size of steam-electric stations has been fixed at 360,000 kilowatts. This limit has been determined by considering on the one hand the ability to transmit energy away from the plant and on the other the hazard incident to the possibility of destruction through unusual catastrophe. A steam pressure of 300 lb. would be used at the turbine throttle with a superheat of 230 deg. F. Proposed coal delivery routes are shown in one of the illustrations and six months' storage capacity for each plant is recommended.

Hydro-electric plants will be limited in size by stream flow and storage capacity. The principal developments are located on nine rivers, but as proposed the estimates for 1925 and 1930 can be justified only if they are included in an interconnected system, as otherwise their output cannot be economically absorbed by the power market.

For interconnection, 960 miles of 220,000-volt transmission lines are needed, together with five times that mile-

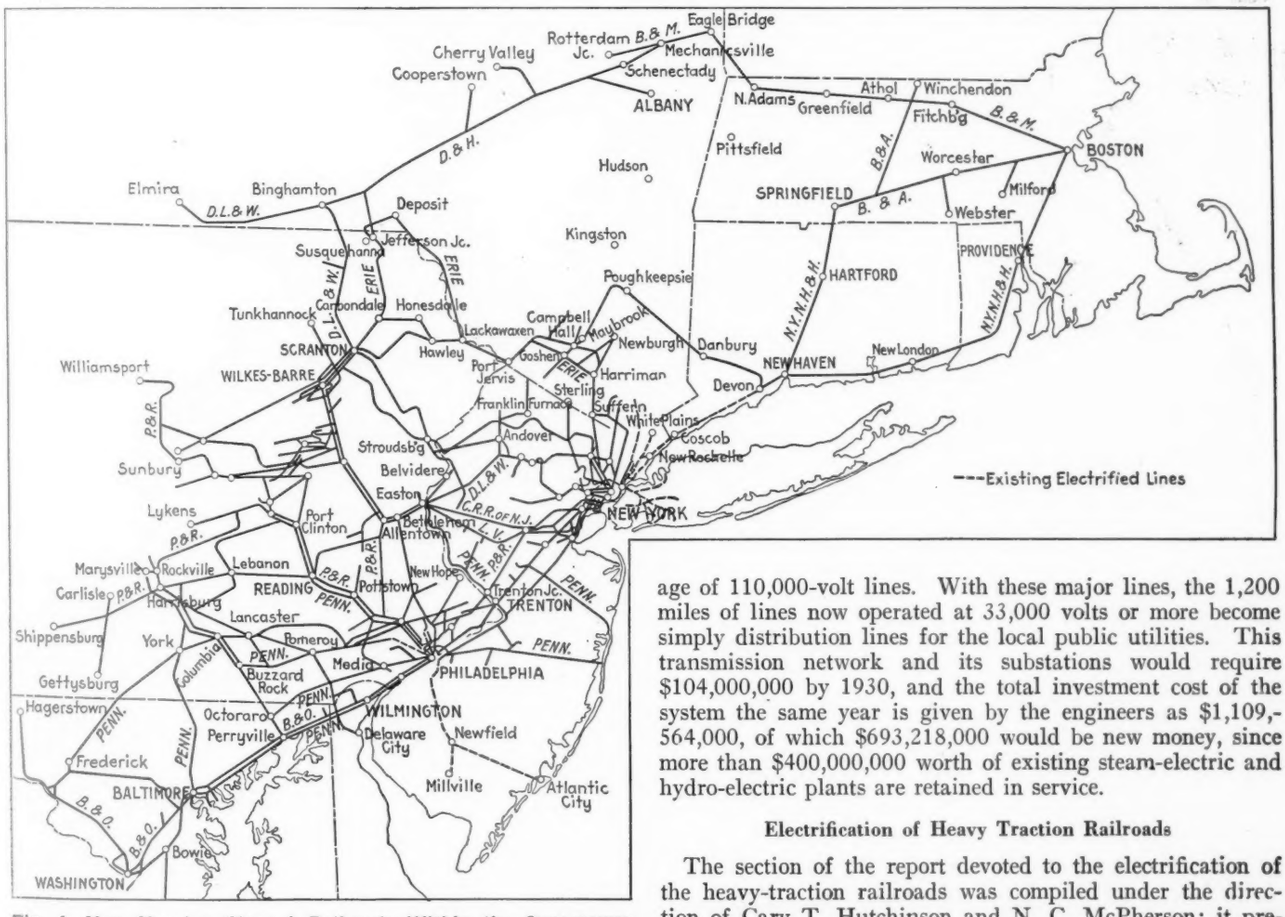


Fig. 1—Map Showing Class 1 Railroads Within the Superpower Zone for Which Electrification Is Recommended

age of 110,000-volt lines. With these major lines, the 1,200 miles of lines now operated at 33,000 volts or more become simply distribution lines for the local public utilities. This transmission network and its substations would require $104,000,000 by 1930, and the total investment cost of the system the same year is given by the engineers as $1,109,564,000, of which $693,218,000 would be new money, since more than $400,000,000 worth of existing steam-electric and hydro-electric plants are retained in service.

Electrification of Heavy Traction Railroads

The section of the report devoted to the electrification of the heavy-traction railroads was compiled under the direction of Cary T. Hutchinson and N. C. McPherson; it presents results of even more general interest than the detailed analysis of the industrial use of electric power. The question of railroad electrification must be decided according to density of traffic; on this basis of the 36,000 miles of main line, yards, and sidings in this superpower zone, about 19,000 could be profitably electrified. This electrification would cost nearly half a billion dollars, but it is estimated that it would save from 11 to 19 per cent on the investment, or an average of 14 per cent per year. The following paragraphs contain an outline of the salient points brought out in this part of the report:

A consolidation of the roads within the district in question

is first suggested which would make it possible to reroute much of the traffic as now handled. Unified operation by electricity would give much better conditions than any that could possibly be attained under unified operation by steam. There would be a new motive power, in which all units or parts designed for similar service would be identical and interchangeable. There would be a pooling of all power, with great reduction of reserves. Repair shops would be consolidated, and maintenance would become a standardized manufacturing job. Track capacity would be greatly increased, and certain tracks would be allocated to freight or passenger service exclusively. All freight trains would be run on schedule; the average speed would be more nearly the same and would be increased to at least 12.5 miles an hour needed to avoid the present punitive overtime payments. Enginehouse facilities would be much simplified by consolidation.

The great expense of any large increase in trackage should of itself force electrification; the total cost 20 years hence will be less if electrification is begun now than the cost of the added track and terminal facilities necessary

Fig. 2—Isolated Industrial Plants in the Superpower Zone

under steam operation to provide for the inevitable 100 per cent increase in traffic within that time.

Motive Power

The entire freight service in the superpower zone can be handled by electric freight locomotives having two articulated two-axle trucks, each carrying two motors geared to the axle, the mounting being essentially the same as that in a number of locomotives now in use and similar to the usual street-car mounting. There would be two classes of locomotives of this type—a light one carrying 80 tons on drivers and having a continuous drawbar pull of 22,000 lb. at 25 miles an hour, and a heavy one carrying 110 tons on drivers and having a continuous drawbar pull of 30,000 lb. at the same speed. These units can be combined in any reasonable number; the total load on drivers can be made equal to 80,110,160,190,220 tons, or as much more as may be desired, being limited only by the strength of the draft rigging. A train can, of course, be double-headed, and a total tractive pull up to the maximum now in use can be obtained, with at least double the present speed.

For passenger service a similar arrangement would be used; that is, two articulated two-axle trucks, with one motor geared to each axle. The motors may be practically the same as those in the freight locomotives, the only difference being a change in gear ratio. The passenger locomo-

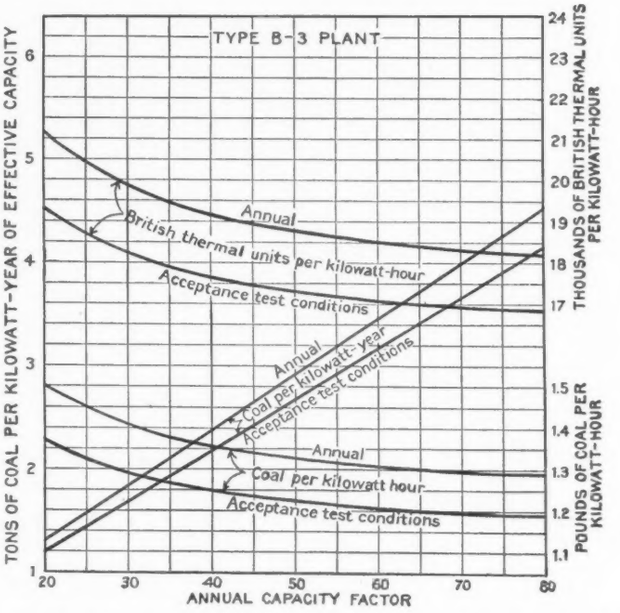

TYPE B-3 PLANT
TONS OF COAL PER KILOWATT-YEAR OF EFFECTIVE CAPACITY
THOUSANDS OF BRITISH THERMAL UNITS PER KILOWATT-HOUR
POUNDS OF COAL PER KILOWATT-HOUR
ANNUAL CAPACITY FACTOR
Annual British thermal units per kilowatt-hour
Acceptance test conditions
Annual Coal per kilowatt-year
Acceptance test conditions
Annual Coal per kilowatt hour
Acceptance test conditions

Fig. 3—Estimated Unit Performance of One of the Base-Load, Steam-Electric Plants; Plant Uses Bituminous Coal, Stokers and 20-Tube High Boilers

tive, however, would have leading and trailing trucks, with either two or four wheels, and the total weight would be redistributed. This passenger locomotive would be of two weights, the light one having 60 tons on drivers, and the

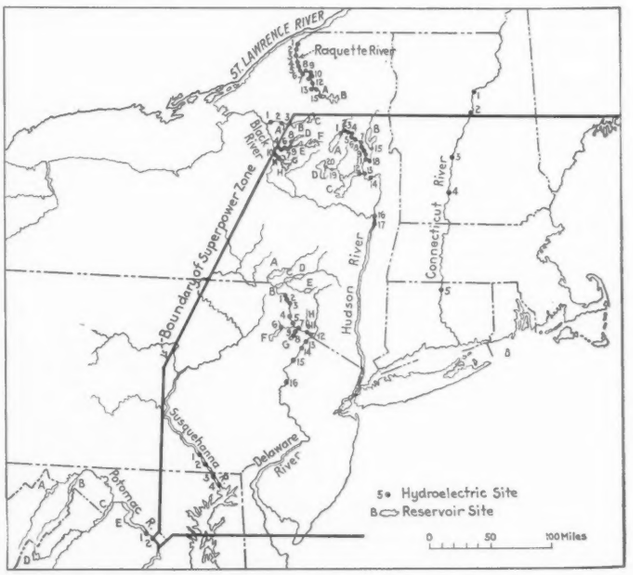


Fig. 4—Principal Hydro-Electric Resources of Superpower Zone

heavy one 90 tons. These also may be combined, like the freight locomotives.

For the switching locomotives, one size will be adequate, with 70 to 75 tons on drivers, of the same type as the freight locomotive. Substantially the same frame and running gear can be used, with motors of less capacity.

All three types of locomotives will have the usual overload capacity, and all will be able to operate in starting and accelerating at 25 to 30 per cent adhesion. These suggested sizes and types of locomotives can, of course, be varied greatly without sacrificing the advantage of unified electric

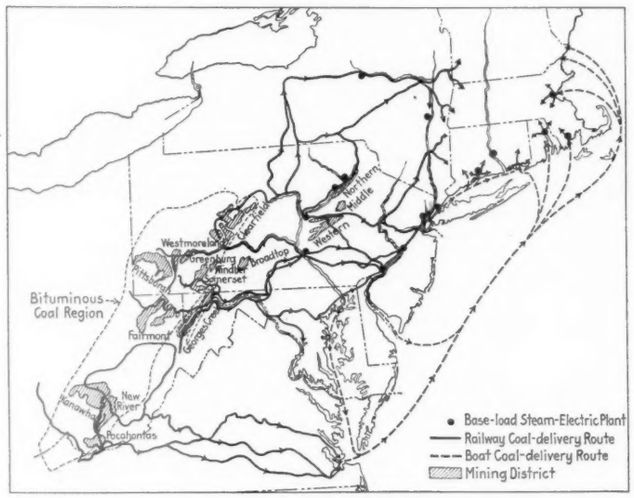


Fig. 5—Location of Principal Coal-Delivery Routes from Bituminous Regions to Base Load Steam-Electric Plants in 1930

operation, but identity of types for the same service throughout the superpower zone is essential.

The only two systems that are applicable to general traction within the superpower zone are the 3,000-volt direct-current system and the 11,000-volt (or higher) alternating-current system, both with overhead distribution circuits and rail return. Both of these systems are in successful use, and both can no doubt be designed and constructed to give satisfactory service in the zone.

Systems of Electrification

In order to avoid some uncertain elements in the estimates of the cost of the alternating-current system it was decided to base all estimates, both of operation and of construction,

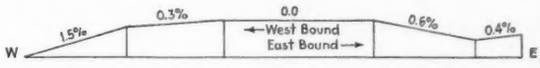


Fig. 6—Profile Used for Making Calculation of Power Requirements

on the 3,000-volt direct-current overhead system. Substantially the same results in money could, however, be obtained with the alternating-current system, certain gains being offset by certain losses.

It was evident at the outset that it would not be adequate to study the roads as units, but that a study should be made of the operating divisions of the railroads. A study of a railroad system as a whole, even if it lay entirely within the zone, would yield only average results, which might make a poor showing, whereas some of the divisions treated separately might make a good showing. It was, therefore, decided to ask each of the Class 1 railroads within the superpower zone, of which a list is given above, to answer questions asking for certain fundamental data as to roadbed, equipment and traffic. This information, as with all other information sought, was to cover the year 1919.

CLASS 1 RAILROADS WITHIN THE SUPERPOWER ZONE

Boston & Maine	Erie
Boston & Albany	Delaware, Lackawanna & Western
New York, New Haven & Hartford	Lehigh Valley
New York Central	Central of New Jersey
Delaware & Hudson	Long Island
Ulster & Delaware	Pennsylvania
New York, Ontario & Western	Philadelphia & Reading
Lehigh & New England	Western Maryland
Lehigh & Hudson River	Baltimore & Ohio

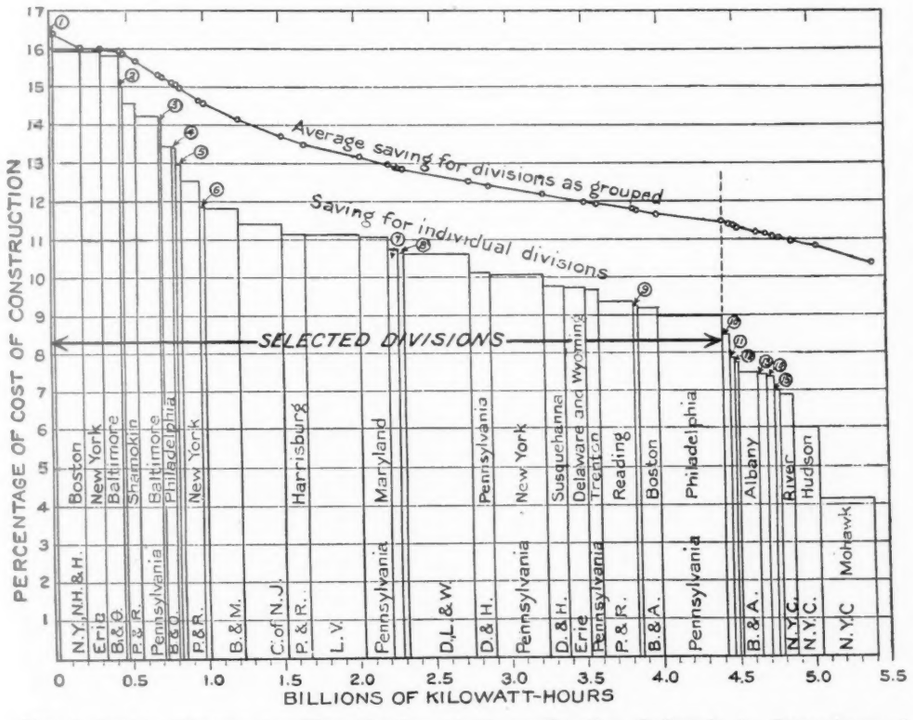


Fig. 7—Saving Effected by Electrification of Heavy-Traction Railroads in Percentage of Construction Costs, Not Including Savings in Wages

In addition to the data from the railroads, two large companies, the General Electric and the Westinghouse, were asked to prepare estimates of cost of substation equipment, of electric locomotives, of catenary construction, and of other facilities—all as of the year 1919. Similar data were also asked of the Ohio Brass Company and one or two other companies.

Electrical Energy Required

The electric energy required for the railroads is determined from the records of lines already electrified, with proper allowance for variations in the conditions of operation, and from calculations based on the profile and the alinement of the roads considered and the efficiency of their locomotive and distribution systems.

In fixing the units of energy for the different operating divisions much weight is given to the results of the New Haven service modified as required by the profile and alinement of the division under examination.

Other records of electric energy for locomotive-drawn trains, both freight and passenger, were obtained from the Chicago, Milwaukee & St. Paul, New York Central and the Pennsylvania. Tables published in the report show the

amount of power used on these roads for freight, passenger and switching service.

The second method of determining electric energy required consists in calculating, from profile and alinement, the work due to normal train resistance and adding to this the net work done against gravity, plus the work due to curvature, plus the work due to acceleration.

Cost of Electrical Equipment and Saving Effected

The quantity of coal burned by a steam locomotive necessary to do one kilowatt-hour of work at the rim of the drivers is estimated at 7.5 lb. Equivalent coal for electric locomotives is uniformly taken at 2 lb. per kilowatt-hour for energy delivered at the substation. All losses of energy in transmission and conversion from the power station to the substation are included in this figure. To make the costs justly comparable throughout, a unit price was adopted for railroad coal in each section: the cost per ton as thus fixed for the several sections of the zone is $5, $5.50 and $6 for the south, central, and northern sections, respectively. These costs include the prorated cost of fuel and water stations.

It is assumed that the railroads will purchase electrical energy delivered at high pressure at substations on or near the railroad right-of-way at the flat rate of one cent per kilowatt-hour.

Maintenance of the electric distribution systems, is taken at $600 per mile for main track and $400 per mile for yard track. The cost of operation and maintenance of substations is based on $1.50 per kilowatt per year of capacity, giving 0.7 mill per kilowatt-hour for a capacity factor of 25 per cent.

It is assumed that there will be an increase in ton-miles per electric locomotive-hour of 33 per cent and a consequent reduction in crew wages per ton-mile of 25 per cent. For passenger service no data are at hand; a general consideration of the subject does not indicate a material saving in wages necessary on account of train crews and therefore none is assumed.

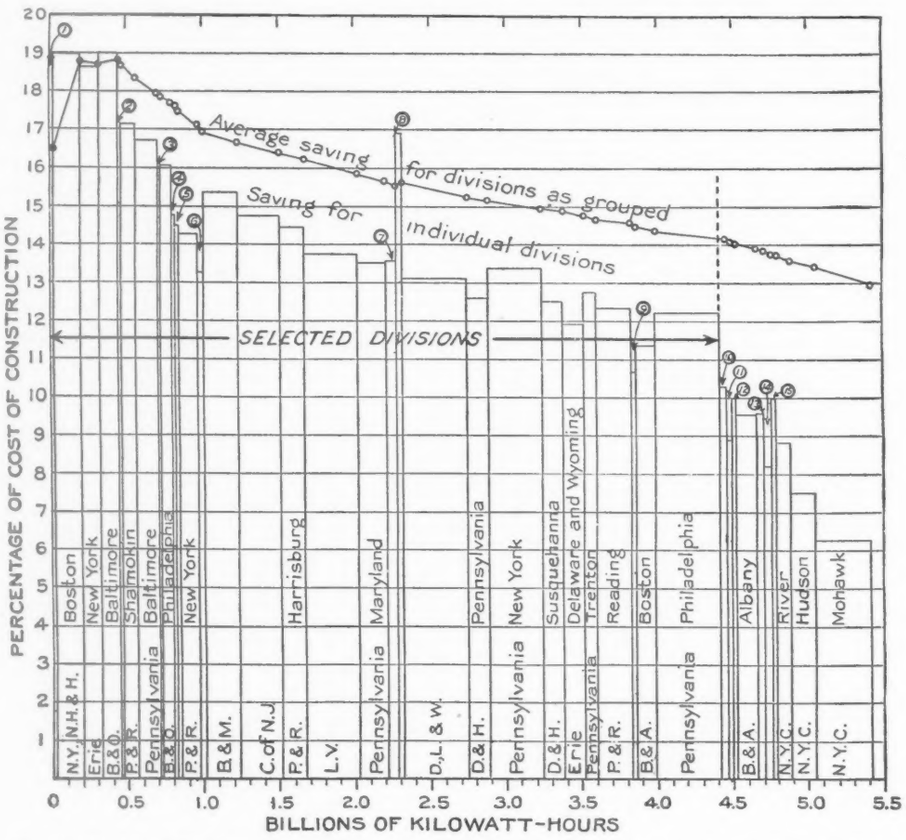


Fig. 8—Saving Effected by Electrification of Railroads, in Percentage of Construction Cost, Including Saving in Wages

It is estimated that the electric switchers will do 50 per cent more work per hour than the steam switchers, and that consequently the wage account for the same service will be reduced by 33 per cent.

In table No. 1 are listed the costs of electric equipment for a typical section of line necessary to make the savings possible with electric operation. The costs given in the table are based on the answers of questions sent to railroads operating within the superpower zone, and the values of track mileage, locomotives, etc., given in the table, are the sum of those values given in the answers received. The total net cost as given in the table represents only the cost of the equipment listed in the table and is indicative of the cost of the larger amount of equipment which could be used economically for electrifying the railroads in the zone.

Costs of catenary are based on estimates made by manufacturing companies which were checked by estimates made by the Chicago Smoke Abatement Commission's report.

The required sub-station capacity, item 3, table No. 1, is based on an analysis of existing installations.

The number of locomotives required is based on an annual mileage of 40,000 for freight, 75,000 for passenger and 40,000 for switcher locomotives. Estimates of costs of locomotives were based on those made by manufacturing companies. These estimates are stated in cost per lb. for the three classes as follows: 40c. per lb. of total weight for freight locomotives and switchers, having all of the weight

TABLE NO. 1

COST OF CATENARY SYSTEM AND ELECTRIC EQUIPMENT

(1)	Catenary system:	Miles	Cost	
	(a) Single track	175	$2,013,000	
	(b) Double track	68	1,700,000	
	(c) Three-track	9	291,000	
	(d) Four-track	42	1,625,000	
	(e) Yards and sidings	221	1,658,000	
(2)	Total			$7,287,000
(3)	Substations ....kilowatts	Capacity 82,100		4,926,000
(4)	Locomotives:	Number		
	(a) Freight	43	$3,440,000	
	(b) Passenger	55	4,576,000	
	(c) Switcher	41	2,657,000	
(5)	Total	139		10,673,000
(6)	Sum of specified items			$22,886,000
(7)	Allowance for unspecified items, 10 per cent of (6)			2,288,600
(8)	Overhead, 20 per cent of (6)			4,577,200
(9)	Total gross cost			$29,751,800
(10)	Credit for released steam locomotives	Total tonnage 30,300		*6,060,000
(11)	Net cost			$23,691,800

*Present value.

on the drivers and 45c. for passenger locomotives, equivalent to $800 per ton on drivers for freight locomotives and switchers, having 70 per cent of the weight on the drivers, and $1,300 per ton on drivers for passenger locomotives. The total weight on drivers of the electric locomotives is the product of their number by the average weight on drivers of the steam locomotives on the division. The minimum number of electric locomotives required for each division is 50 per cent of the corresponding number of steam locomotives, even if the number based on mileage is less than 50 per cent.

Item 8, table No. 1, covers overhead allowance of 20 per cent for engineering, interest and contingencies which are difficult to predetermine.

It is assumed that all steam locomotives released by electrification can be used and it is also assumed that the average

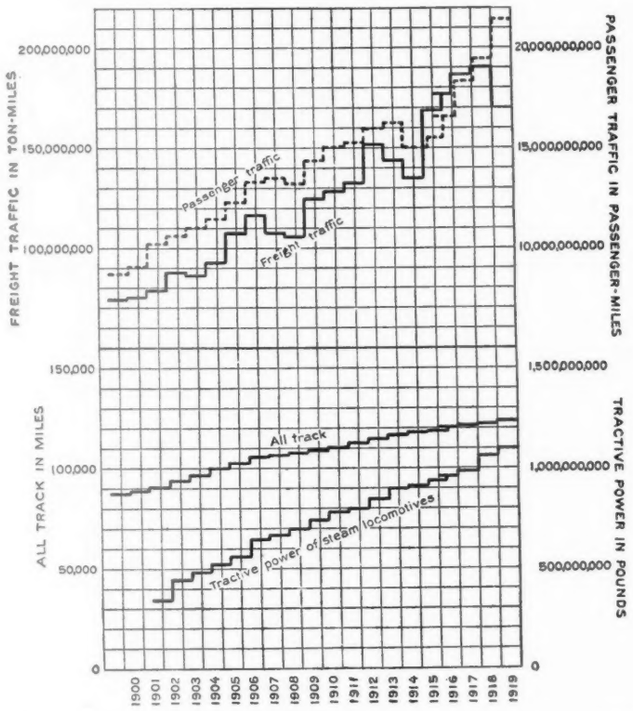


Fig. 9—Growth of Steam Railroads in the Superpower Zone, 1900 to 1919

condition of the locomotives released is 50 per cent new. The value of a new locomotive in 1919 is taken at 18c. per lb. of total weight, and the salvage value at 2c. per lb.

Conclusions

Following the procedure outlined in the preceding paragraphs, a study was made for all the Class 1 railroad systems within the superpower zone except the Ulster & Delaware, the New York, Ontario & Western, and the Western Maryland. The first two were omitted after a preliminary examination because their traffic was too light to warrant electrification. The Western Maryland was omitted because only a small part of its traffic is within the zone; the preliminary examination, however, indicates that the Western Maryland traffic would justify electrification. This left a remainder of 13 railroads in the zone that were studied. The Boston & Albany was included with the New York Central and the Long Island with the Pennsylvania. It was not possible in this study to adhere strictly to the limits of every operating division reported by the railroads, and some divisions were therefore consolidated into routes. The number of divisions or routes range from one on the Boston & Maine to nine on the Pennsylvania and aggregated 40 for the 13 roads.

The results of the study are given in Figs. 7 and 8 which show for each of the 40 divisions the annual saving, in percentage of the net cost of electrification, plotted against the energy required, in kilowatt-hours per year, together with the accumulated average percentage of saving for the divisions as grouped. Fig. 7 shows the saving exclusive of the saving in crew wages, and the divisions are arranged in the order of percentages. With these results as a criterion of economical electrification the "selected divisions" are assumed to be all that show a saving of nine per cent or more. The group of divisions thus selected shows an average saving of 11.4 per cent. It includes 30 of the 40 divisions examined, comprised in 11 of the 13 systems. The saving, including the wage saving, for the 40 divisions, is shown in Fig. 8. For the "selected divisions" these savings range from 10.6 to 19 per cent and average 14.2 per cent. The total energy required annually for these 30 divisions would be 4,400 million kilowatt-hours, and the maximum demand approximately 850,000 kilowatts.

The low percentage of saving shown by the divisions not included in the selected group, except those of the New York Central, is due to light traffic. On the New York Central the train cost of transportation, the cost of maintaining steam locomotives and the cost of coal per mile are lower than on any other system, owing in part to the fact that this is a water-level road with a large amount of through traffic; these are favorable conditions for economical steam operation and afford less opportunity for saving by electrification.

The amount of electrification recommended includes 48 per cent of the route miles, 53 per cent of the main track miles, 64 per cent of the yard track and 58 per cent of all track owned by the 11 selected roads in the district. The net cost of electrification of all the selected divisions would be $570,000,000, and the net annual saving in operation, including the saving in wages, $81,000,000 equal to an average of 14.2 per cent of the entire group, ranging from 10.6 per cent for the New York, Susquehanna & Western division of the Erie to 19 per cent for the New Haven-Boston route of the New Haven.

The growth of traffic, both freight and passenger, of track, and of tractive power for the Class 1 railroads in the superpower zone from 1900 to 1919 is shown in Fig. 9. The annual rate of growth has been 5.3 per cent in passenger-miles, 4.5 per cent in ton-miles, 0.75 per cent in all track, and 6.6 per cent in tractive power of locomotives.

The amount of money required for electrification is $570,000,000. This figure is based on costs prevailing in 1919, but at costs as of June, 1921, it would be reduced by 18 per cent, to approximately $467,000,000, and before this construction can be undertaken there would be further material reductions. Probably five years from now the entire work outlined could be done for not more than $400,000,000. Good railroad authorities have stated repeatedly that more that $1,000,000,000 a year is needed by the railroads of the United States for extensions and betterments. The part of this total to be allocated to the superpower zone, as determined by the number of locomotives, would be $150,000,000. The amount required for normal extensions and betterments for three years would, therefore, be sufficient to electrify the 30 selected divisions of the railroads in this territory, with an annual saving of more than 14 per cent. The most valuable feature of the change, however, is not the amount saved, but the great increase in maximum capacity of existing trackage and general advantages of electric operation.

These figures indicate that with a return of normal financial conditions all these lines should be electrified before further great expenditures have been incurred to increase in a minor degree the capacity of the existing tracks and yards. Steam operation cannot satisfactorily meet the conditions of the crowded terminals herein described as the superpower zone; electric operation can easily do it.

Method of Laying Out Walschaert Valve Gear

Designing to Compensate for Angularity; Fixing Principal Dimensions of Parts

BY J. J. JONES
American Locomotive Company, Schenectady, N. Y.

WHILE the Walschaert valve gear had been previously used on American built locomotives, its present almost universal application may be said to have begun with the Baltimore & Ohio Mallet locomotive built by the American Locomotive Company at its Schenectady plant and exhibited at the St. Louis exposition in 1904.

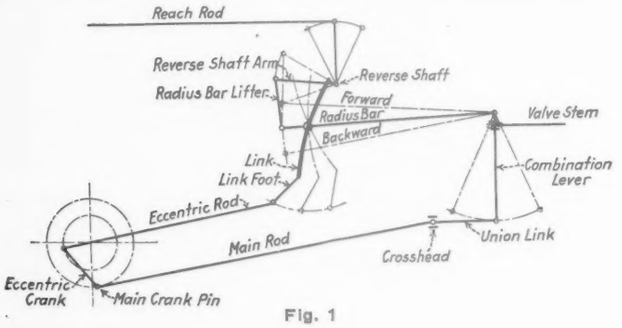


Fig. 1

This engine attracted a great deal of attention in the railroad world at that time, not only on account of the valve gear, but also because it was then the largest and most

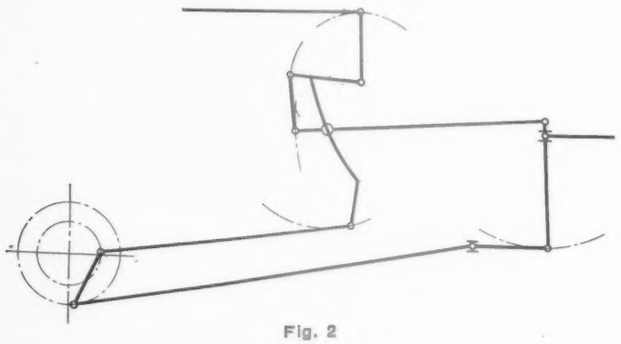


Fig. 2

powerful locomotive in the world, and marked the introduction of the Mallet as it is now known on American railways.

The writer's first practical experience with the Walschaert

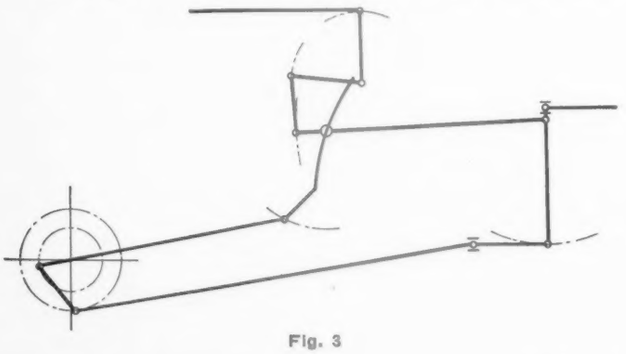


Fig. 3

valve gear was as elevation draftsman in the building of this locomotive and as he has since been closely connected with the designing and application of this gear an outline of his method of laying it out may be of interest. In submitting this it is assumed that the reader has a good understanding of locomotive design and it is not necessary to

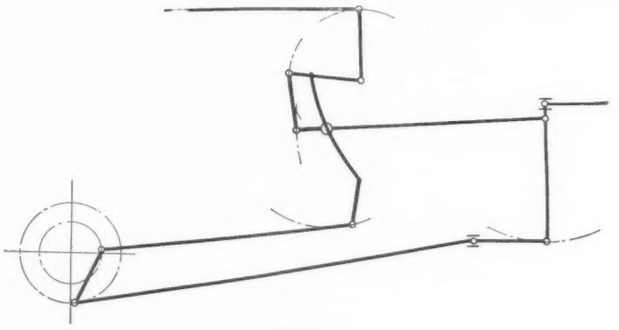


Fig. 4

explain the construction of the valve or flow of steam to and from the cylinder.

Before starting the layout of the gear the general design of the engine is studied to determine which of the various

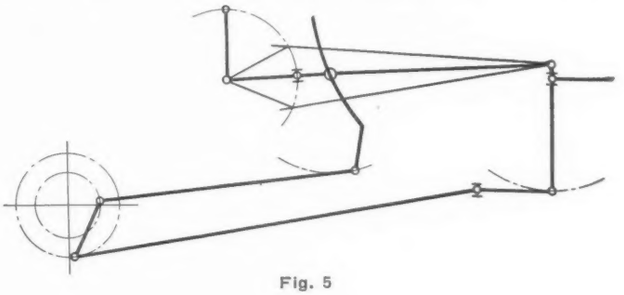


Fig. 5

arrangements of reverse shaft, etc., is most suitable. Diagrams of several arrangements in common use are shown by Figs. 1 to 6.

The arrangement most used by the American Locomotive

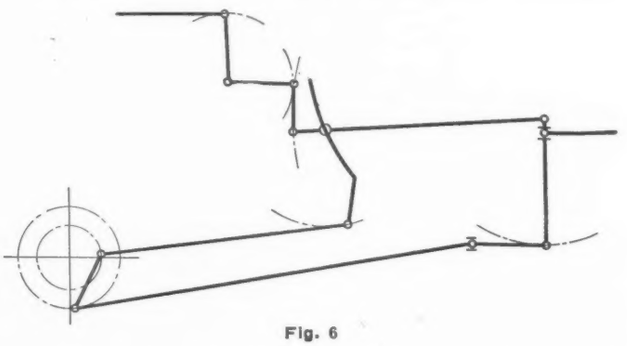


Fig. 6

Company is shown in Fig. 1. This is arranged for inside admission with the eccentric crank leading the main crank pin and the radius bar in the top of the link in the forward motion. With this arrangement the irregular movements due to angularity of the main rod are compensated by the angu-

larity of the eccentric rod, consequently it will produce the nearest to perfect results as to cutoffs, etc., at all positions of the reverse lever.

The arrangement shown in Fig. 2 is similar to Fig. 1, but the eccentric follows the main crank, which places the radius bar in the bottom of the link in forward motion.

An arrangement for outside admission, with the eccentric leading and the radius bar in the bottom of the link in forward motion is shown in Fig. 3. This, on account of the leading eccentric, has the same advantage as regards perfect results for all reverse lever positions as Fig. 1.

Fig. 4 is the same as Fig. 3 except for the following eccentric and forward motion in the top of the link.

Fig. 5 shows an arrangement in which the radius bar lifter is in the form of a slide carried by the reverse shaft arm.

Fig. 6 shows an arrangement similar to Fig. 2, except that the center of the reverse shaft is located back of the link. The names of the various parts are indicated in Fig. 1.

After selecting the arrangement to be used, it is necessary to decide where it will be best to locate the center of the link and the vertical center line of the combination lever on the elevation drawing, having in mind proper clearances

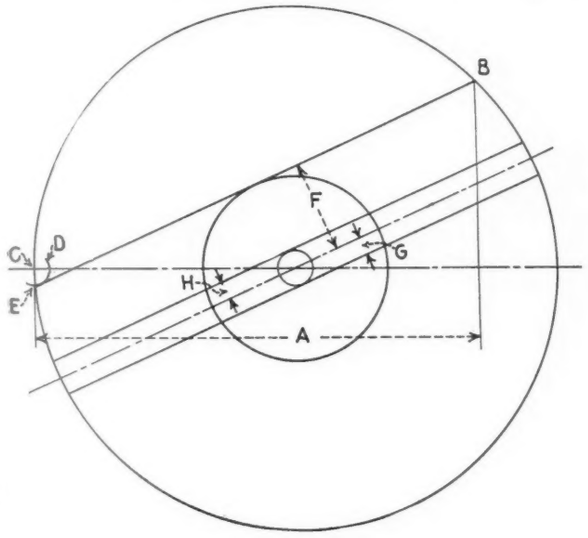


Fig. 7

from other parts of the engine. The location of the link should, if possible, be such that the radius bar will not be longer than the eccentric rod, a good arrangement being to make the radius bar approximately three-quarters the length of the eccentric rod.

It is also advisable to locate the link as low as possible so as to avoid excessive length of link foot. It should not, however, be so low as to involve an excessive angle between the radius bar and valve stem at the lower end of the link unless provision is made in the valve stem guide to withstand the higher thrust.

Having settled these points, the designer must decide what valve setting is to be used; viz, maximum valve travel, steam lap, lead and exhaust clearance or lap. These dimensions are usually decided from previous experience with similar locomotives so that it is seldom necessary to do more than pick out the setting suitable for the case in hand; however, the setting may be decided graphically by means of the Reuleaux or similar diagram.

The Reuleaux diagram, Fig. 7, which is probably the most easily understood, is constructed as follows: Draw a circle whose diameter is equal to the assumed valve travel, then on the horizontal diameter measure a distance that is the same per cent of the whole diameter as the desired maximum per cent cut off and draw a vertical line to point *B* which will correspond to the cut off position of the crank pin if the circle is also considered as the path of the crank pin and dead center or beginning of the stroke at point *C*.

Now draw an arc *D* of radius equal to the assumed lead and then draw line *E-B* tangent to arc *D*. The required steam lap is then shown by the distance *F*.

Exhaust clearance or lap is determined by drawing a line parallel to line *E-B* through the desired release or closure position of the crank pin; exhaust line and line is shown

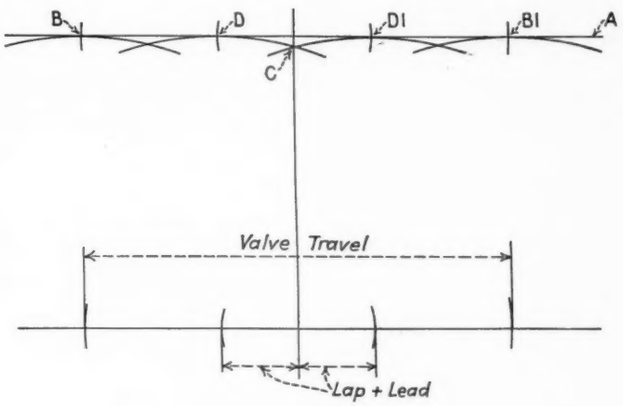


Fig. 8

by a line through the center of the circle. *H* indicates exhaust clearance; *G* indicates exhaust lap.

As this diagram does not take into consideration irregularities due to angular movements of the main rod, etc., the results will not be exactly the same as will be obtained on the engine, but will be a close approximation only and, therefore, if a certain maximum cut off is desired, it is best to make the lap, travel, etc., such that the diagram will show about one per cent longer cut off.

The center line layout of the gear is now started (see Fig. 10) making it to as large a scale as convenient and as accurate as possible, if necessary, using a magnifying

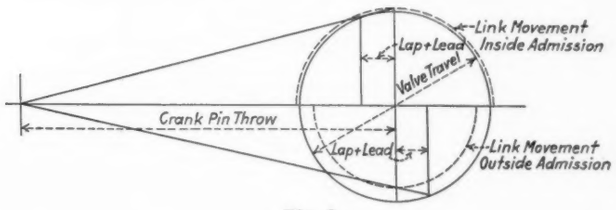


Fig. 9

glass to insure that centers are exactly on the intersections of lines. The next step is to lay out the center lines of axle, crank pin circle, cylinder, crosshead wrist pin in center of stroke, link, valve stem and vertical center line of combination lever.

The dimensions of the combination lever are then determined by the following formula:

$$A : B : : X : Y \text{ or } \frac{AY}{B} = X \text{ in which}$$

A = (Lap + lead + 1/32 in.) × 2
B = Equals stroke of engine.
Y = Distance between radius bar and union link pin
X = Distance between radius bar and valve stem pin.

(The 1/32 in. in the formula above is to compensate for lost motion in the finished gear.)

A distance equal to the lap plus the lead is then measured off on the valve stem center line each side of the vertical

center line of the combination lever, also half the valve travel as shown in Fig. 8. Then with these points as centers and radius *X*, draws arcs which intersect the vertical center line at point *C* and are tangent to a line *A*, which shows the highest position of the radius bar pin.

The points *B* and *B*1 are then located on line *A* to show the amount of movement of the radius bar pin necessary to obtain the required valve travel, which is determined as indicated in Fig. 9 and shown by the dotted line marked "link movement."

The next step is to locate points *D* and *D*1 equidistant from the center line for about half full link movement.

Then from point *C* with the distance to the center of the link as radius, the arc *E* (Fig. 10) is drawn which shows the central position of the link, and from the center of the link with the same radius arc *F* is drawn on which the centers of the link at full swing front and back are later located.

It is then necessary to decide the maximum lift of the link block to be used, allowing proper clearances at the ends of the link, and draw the link circle *G* which is used only as a limit line beyond which the link block must not travel.

With a radius equal to the radius of the link and *B* and *B*1 (Fig. 8) as centers, arcs *B* and *B*1 are drawn which at their intersection with the link circle show the maximum possible movement of the link block. Shorter arcs are also drawn from points *D* and *D*1 as centers.

Centers are now located on arc *F* equidistant from point *C* so that when an arc is drawn through the center of the crank is found by measuring the distance to the dead center of the crank pin as shown, the eccentric being either leading or following the crank pin as required by the gear arrangement.

Lines are now drawn from points *B*, *B*1, *D*, *D*1 and *C* through the intersections of their arcs with the arcs of full link swing to show the center lines of the radius bar for

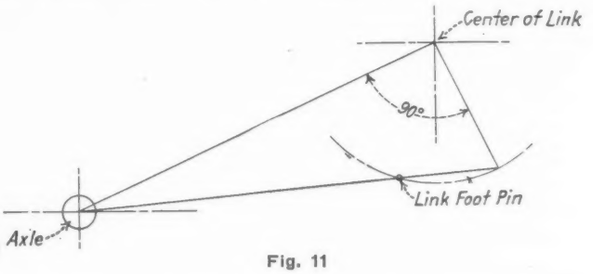


Fig. 11

these positions of the link block, and to locate points to show corresponding positions of the radius bar lifter pin. Then with these points as centers and the length of the radius bar lifter as radius, draw intersecting arcs to fix points from which to locate the center of the reverse shaft so that with the length of reverse shaft arm decided on the suspension pin for the radius bar lifter will travel as near as possible to the points thus found.

It now remains only to determine the correct length of the union link, which should be such that the angle of

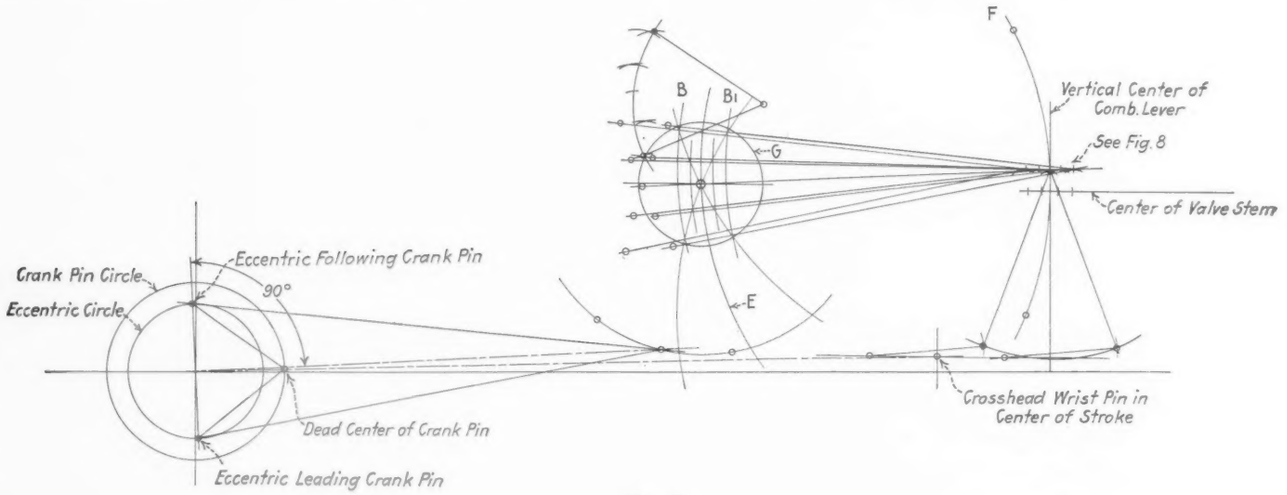


Fig. 10

link it will intersect arcs *B* and *B*1 inside of the link circle. This locates the full swing of the link.

The next step is to locate the link foot pin and find the diameter of the eccentric circle that will give the angular swing of the link that is shown by the arcs of full swing.

These are determined by trial as there is no accurate rule for determining them and must be such that when the eccentric is located 90 deg. from the center line through the axle and link foot pin the resultant swing of the link will be the same each side of the center and same amount as shown by the arcs of full link swing.

In this connection the nearest approximation of the correct location of the link foot pin known to the writer is shown by diagram in Fig. 11. This, however, usually gives a point that is two or three degrees too far back and therefore should be considered only as a simple method of finding the first trial center.

After the link foot pin position and the diameter of the eccentric circle are determined, the length of the eccentric swing of the combination lever will be the same each side of its vertical center line. The proper length is equal to the distance from the crosshead wrist pin to the lower pin of the combination lever when laid out for the end of the stroke, and not when laid out on the vertical center line.

The reader will no doubt have noted that the dead center positions of the crank pin in the layout are on the line drawn through the center of the axle and crosshead wrist pin at the center of the stroke and that these dead centers do not check with the true dead centers when the center line of the cylinder is above the center of the axle.

While the latter gives the actual dead centers that will be used by the valve setter, greater accuracy in the length of the eccentric crank is obtained by using the centers as shown, the slight error being in the length of the eccentric rod if measured on the layout.

The amount of this error may be determined by revolving the eccentric around the center of the axle the small angle represented by the distance from the assumed to the true

dead center; then the distance from the eccentric to the center of the pin in the link foot is the correct length of the eccentric rod.

If the laying out is carefully done no adjustments will be found necessary, when setting the valves in the shop, except possibly a slight lengthening or shortening of the eccentric rod or radius bar to compensate for unavoidable inaccuracies in workmanship.

Operating and Maintaining Oil Burning Locomotives*

Oil Tanks; Piping; Location of Burners; Drafting; Preventing Air Leaks; Cleaning Soot from Flues; Maintaining Oil Temperatures

THE first attempt in the United States to burn crude oil in the firebox of a locomotive was made at Santa Paula, California, in October, 1894. The subsequent study of combustion soon led to a better understanding of the firebox and boiler design and realizing the many advantages to be gained by the use of oil as fuel, every effort was made to develop the most efficient burner and drafting arrangement. Most obstacles were overcome and in a comparatively short time a high degree of efficiency was attained.

Crude oil possesses many advantages over other fuels and in the West its use soon becomes widespread. At no time during the past few years has the production of crude oil in the United States been sufficient to meet requirements, and records for June, 1921, show the consumption of 81,000 barrels per day in excess of production, which deficit was and is being supplied from the Mexican fields.

Daily production, United States, June, 1921	1,346,833 bbls.
Imports from Mexico	340,175 bbls.
Total	1,687,008 bbls.
Daily consumption	1,427,367 bbls.
Amount placed in storage daily	259,641 bbls.

At the present rate of consumption we are told by geologists that the crude oil supply in the United States will be exhausted within a few years as there now remains but about 60 per cent of the original supply underground. With this prospect in sight it is small wonder that strenuous efforts are being exerted to conserve the remaining supply by maintaining and operating oil burning locomotives as economically as possible. At the present time there are about 41 railroads operating in 21 states which burn oil for fuel, some, however, on a very small part of their power.

The maintenance of the locomotive rests largely with the enginemen. The medium through which the maintenance is accomplished is the work report and its correct rendition. This means that if the locomotive is to perform economically at its maximum capacity specific information must be given to the roundhouse force as to just what defects were noted under actual operation. Maintaining an oil burning locomotive would be a very simple task if a thorough and accurate report of defects noted by engine crews were reported at the end of each trip. "Don't Steam" covers a multitude of sins but the worst sinner of all is the man who writes it on his work report, with no further detail, and then has writer's paralysis.

Generally speaking there are but few points of difference in maintaining an oil burning locomotive as compared with a coal burner and these points of difference affect the design of tender, oil piping and firebox arrangement. The fuel oil tank is constructed of ⅜-in. material and the capacity is approximately 3,000 gallons—a coal equivalent of about 17 tons on the basis of 42 gallons per barrel and 4 barrels of oil equal to a ton of coal. On filling the square tank a 2-in. space is left in the top and on semi-cylindrical 6 in., to allow for expansion when the oil is heated. The ratio of expansion is one per cent for each 25 deg. F. increase in temperature. Fuel tanks are provided with a measuring rod designed to show inches on one side and gallons on the other so that accurate measurements may be obtained at all times.

Oil flows to the burner by gravity on all types of locomotives except the Mallet, in the tender of which is used six pounds air pressure. The oil piping arrangement conveys the oil from the tank to the burner, from which it is sprayed into the firebox by steam. This conduit is two inches in diameter and passes through a superheater four inches in diameter which is used, in addition to the tank heater, to heat the oil before it reaches the firebox. The tank heater should be so constructed and maintained as to keep the oil at the proper temperature, the oil feed line should be free from leaks, with as few elbow joints as possible; metal with flexible joints is preferable to rubber. The cut-out or safety valve on the tender, the blow-back valve, superheater and firing valve should all be in perfect working condition. Burner should be of suitable size, varying from one inch to three inches according to size of firebox, clean and lined up about 60 in. from the flash wall to insure perfect combustion. The correct distance from burner to fire pan floor is 6 in. to 9½ in., depending on the draft arrangement, and particular attention should be given to see that the burner is so placed that the oil strikes the flash wall in the center. Care must also be exercised to see that fire pan is free from air leaks with no obstruction on the floor and that all damper controls are in perfect working order.

There are two ways of drafting an oil burning engine; one, the horizontal draft and the other the vertical. Both are in general use on oil burning roads. The arrangement of the brick work on both drafts is practically the same. The horizontal draft, by which air is admitted through the fire door, is the most economical, but in poor water districts, from the standpoint of boiler maintenance, the vertical draft arrangement with the flat door, by which air passes to the rear of the firebox, prevents cold air from reaching the stay-bolts and thus reduces boiler maintenance. The horizontal draft in good water districts has proved very successful both from the standpoint of boiler maintenance and fuel consumption.

Air openings through the fire pan should vary, depending on the size of the firebox—from 16 sq. in. air admission around the burner and 85 sq. in. at the rear of the firebox, to 225 sq. in. around the burner and 224 sq. in. at the rear. It has been found that the best results are obtained on an oil burning engine with the use of an extension stack extending down to the center line of the boiler, 12 to 16 in. in diameter.

To secure the best results the fire pan should be welded to the mud ring and rigidly secured so as to obviate all possibility of air leaks at sides and front or behind the brick work. Too much attention cannot be given to the maintenance of fire pans on oil burning locomotives.

Front end air leaks and outside steam leaks should not be tolerated. In the roundhouse one man should be assigned to make torch tests and repair all air leaks into the front

*Abstract of a report presented at the meeting of the Traveling Engineers' Association, at Chicago, September 8, 1921.

end and around outside steam pipes. There are many recommended practices for the elimination of air leaks around outside steam pipes. The best one in use is the application of a casing of ¼-in. steel plate with a welded seam. This casing is riveted permanently to the smoke box and then caulked or welded around the edge to make it airtight. It is large enough in diameter to allow removal of the steam pipes without disturbing it. The lower end of the casing is flanged outward and to it is riveted a wrought iron ring. A cast iron flange made in halves is fitted together and bolted snugly around the steam pipe, which is machined true at this point. This flange is secured to the wrought iron ring with eight studs and a copper wire gasket is used between them to obtain an airtight joint. A copper gasket is then caulked into a dovetail groove in the cast iron flange around the steam pipe.

Operation of oil burning locomotives call for the same attention from the engineer as on a coal burner but the fireman has no manual labor to perform in delivering fuel to firebox. But he has to be alert at all times for there is no bank of burning coal to aid him in keeping an even firebox temperature when the engineman is working a light throttle or drifting after having forced the locomotive to its capacity. A supply of clean, gritty sand should be used in the sand box of the locomotive with a sand scoop so the fireman can clean the soot from the flues. Flues should be sanded while running by placing a small quantity of sand in the scoop and by inserting through an opening in the fire door while the engine is working hard, allowing the exhaust to draw the sand through the flues. It is good practice to sand frequently in order to keep the soot removed. It is a nonconductor of heat and causes the steam pressure to drop rapidly. Enginemen should take care to give the valve sufficient travel and open the throttle far enough so that the exhaust will carry sand through the flues and do the work for which it is intended. The sand scoop should be held as far in the fire door as possible in order to prevent sand from falling on brickwork or flash wall.

Firemen should watch the temperature of oil and endeavor to keep it just warm enough to insure an even flow to the burner. This temperature will vary from 100 deg. F. for light California or Texas oil to 180 deg. for heavy Mexican oil. The fireman has direct control of the amount of steam used to heat the oil in the tender and unless he is careful he may not only damage the oil by overheating it so that it loses its lighter gases, but also increase the danger of explosions from the escaping gas. Where excessive steam is turned into the tender there is excessive condensation and unless this water is drained off it will go to the burner and often puts the fire out. Heating the oil in the tender is not for the purpose of aiding in burning it but to cause it to flow in a steady, even stream from the tender to the oil feed line, where it passes through a superheater box before it reaches the burner. The purpose of the superheater is to raise the oil to a temperature at which it will be easily broken up by the atomizer as it goes from the burner tip into the firebox. Since it takes less than one-fifth of a second for a particle of burning oil to travel from the burner tip to the flue sheet, it is of the utmost importance to have oil so atomized that no time is lost in burning it. The use of the blower is to create sufficient draft to keep the firebox clear of smoke and gases and to produce artificial draft. The misuse of the blower causes waste of fuel and damage to the boiler. Very light applications should be indulged in under all conditions. The strong use of blower draws cold air into the firebox, damaging the flues and flue sheets, and causing them to leak.

A slight color of smoke at the stack is better than no smoke at all, for a clear stack indicates too great an amount of air. Losses from too much air are frequently three times as great as from insufficient supply. Firemen should avoid black smoke at all times if possible; it indicates a loss of fuel and should not be tolerated. Black smoke is either the result of faulty firing or the condition of the engine. The firing valve by which the flow of oil to the burner is regulated requires constant attention. Lost motion frequently occurs in this apparatus. Much fuel is wasted when the fireman loses the correct adjustment of this valve because of too much play either in the rods or in the valve itself.

When an engine is worked to full capacity on long grades and has been fired heavily it requires very careful attention to prevent flues from leaking as the small tongue of flame does not fill firebox sufficiently to keep out the cold air. Enginemen cannot be too careful at such times; they should start gradually to ease off on the throttle, allowing the fireman plenty of time to adjust his firing valve. Injectors should be shut off at once, if only for a short time, and then worked at short intervals. In most cases engines start leaking while descending grades after having been worked hard. Careful team-work between engineer and fireman will prevent black smoke when shutting off or pulling out of stations.

The report was signed by J. N. Clark (Chairman), Sou. Pac. Co.; J. C. Harris, G. H. & S. A.; H. H. Kane, Gulf Coast Lines; E. F. Boyle; E. E. Cornish, M. K. & T., and W. G. Tawse, Locomotive Superheater Company.

Discussion

In answer to a number of questions relative to the terminal handling of oil burning locomotives, J. N. Clark (Southern Pacific) stated in closing that from 50 gallons to 175 gallons of oil are required to fire up engines at terminals, requiring from 30 min. to 1 hr. 50 min. before leaving time. A test made with a 2-8-2 type locomotive weighing 207,000 lb. on drivers, was fired up with ⅓ glass of water at 120 deg. in a total time of 108 min. to 200 lb. gage pressure, with a consumption of 119 gallons of oil. In comparison with 15 per cent to 25 per cent of the fuel consumed at terminals on an eastern coal burning road, the terminal oil consumption was estimated at about 8 per cent of the total fuel.

Mr. Clark referred to a test made under the supervision of the fuel conservation committee of the Southern Pacific in which the fuel consumption per 1000 ton-miles was measured for a 1,000-ton train hauled by a 2-10-2 type superheated locomotive. At 5 miles an hour the oil consumption was .3 gal.; at 10 miles an hour, 1.1 gal.; at 15 miles an hour, 2.5 gal.; at 20 miles an hour, 4.5 gal.; at 25 miles an hour, 7 gal.; at 30 miles an hour, 10 gal.; at 35 miles an hour, 13.7 gal.; at 40 miles an hour, 18 gal.; at 45 miles an hour, 22.7 gal., and at 50 miles an hour, 28 gal. A test to show stand-by fuel consumption showed that 45 gal. of oil per hour was refined to hold train and run the air pump, while 37 gal. an hour was burned by a light engine standing under steam.

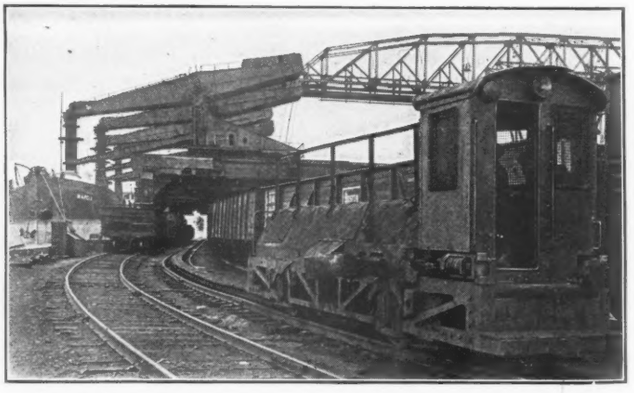


Photo by Ewing Galloway

Ore Docks on the Lake Front at Cleveland

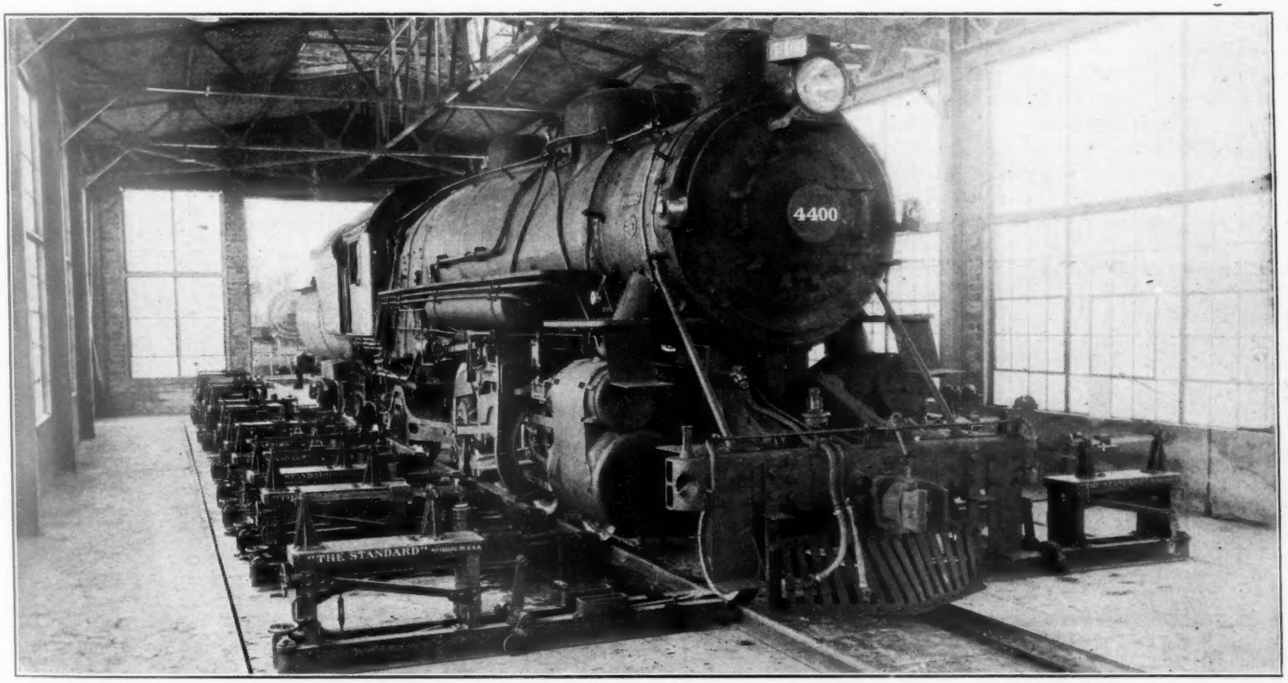
Locomotive Weighing Plant of Large Capacity

Heavy Scale Is Housed in a Special Building with Equipment for Determining All Wheel Loads at One Time

BY CARL C. BAILEY
Baldwin Locomotive Works, Philadelphia, Pa.

A LOCOMOTIVE weighing plant was recently completed at the Eddystone plant of the Baldwin Locomotive Works, which is unsurpassed in size and novelty of construction. It is comprised of a platform track scale, 24 individual wheel scales, concrete foundations of massive construction, and a specially designed building which covers and protects the scale and its mechanism. The large scale is composed of six-sections, and is designed for a total working capacity of 450 tons.

The Baldwin Locomotive Works heretofore determined the total weight of the locomotive on a track scale, after which the individual wheel loads were obtained by moving the locomotive to a specially constructed track having concrete foundations of sufficient width to allow the placing of individual scales under each wheel. With this method of weighing, it was difficult to obtain any degree of accuracy when comparing the weight on the platform with the total weights on the individual scales.



A Locomotive on the Scales with the Portable Wheel Scales in Position

After investigations relative to the assumed loading of the largest locomotive which it would be practical to build, it was decided to construct a scale having a working capacity, as previously mentioned, of 450 tons, with a platform of sufficient width to permit the use of individual scales under each wheel. A scale of this type would give accurate results and all weights would be determined with the engine in one location.

In designing the scale the stresses as recommended by the specifications of the American Railway Association, as well as those of the United States Bureau of Standards, were taken into consideration. However, the necessity for rigid limitations on deflection in the longer extension levers, resulted in designs which in many instances give unit stresses very much below specification limits. To conform to these specifications, the designers were confronted with the question of producing a knife edge in the main levers of sufficient length to give a unit loading not to exceed 7,000 lb. per lineal inch, and also with the problem of supporting it in a substantial manner to secure an even distribution of the load. These knife edges are 22 in. long and are made of a special alloy steel which, when hardened in oil, has an elastic limit of not less than 160,000 lb., and a tensile strength of not less than 200,000 lb. per sq. in. The entire surface of all pivots and bearings throughout the scale is machined, hardened and ground and set in machined ways. All bearing steels for fulcrum stands are set in removable blocks that may be lifted off the stands. These knife edges are so constructed as to have continuous contact with their bearings and there are no bow loops in this scale except those for counter-balancing or back-balancing the weigh beam.

There are 12 cast steel main levers weighing approximately 1,075 lb. each. They rest upon fulcrum stands at one end and are suspended by a stirrup 2¼ in. in diameter at the other. From these the massive cast steel yokes that carry the platform are suspended by two heavy machine steel stirrups 3 ft. long and 2¾ in. in diameter.

The connection between the middle extension lever and the tranverse extension is accomplished by means of two machine steel stirrups 1½ in. in diameter that pass over bearing blocks which engage the butt pivot of the tranverse lever

and the end pivot of the middle extension lever. These stirrups are then connected by a 2-in. plate which permits vertical adjustment.

The connection between the middle extension lever and the 3-ft. even lever consists of two machine steel stirrups of 1⅛-in. diameter that pass over the bearing blocks which engage the end pivot of the middle extension lever and end pivot of the even lever. These stirrups are connected by means of two 1½-in. plates and two draw bars 1⅛ in. in diameter. At the fulcrums of both the even and the extension levers, there is an up-pull. These fulcrums are anchored to the sub-bases by means of two cast steel anchors in the form of an inverted stirrup, one at each side of the lever. Each stirrup is held down by two 1¼-in. anchor bolts.

The connection between the transverse extension lever and the lever under the weigh beam is composed of stirrups, plates, draw bars and bearing blocks, all so arranged that one lever may be leveled independent of the other, that proper swiveling can take place to match the different angles at which the levers hang, and to give vertical adjustment to the levers in unison.

The weigh beam on the platform scale is graduated to 895,000-lb. capacity by 5,000 lb., with an auxiliary beam of 5,000-lb. capacity by 50 lb., giving a total capacity of 900,000 lb. This weigh beam is of "The Standard" type with a pin recording attachment. The main weigh beam, as well as those of the individual scales, is made of high grade cast iron, fitted with steel inserts for the notches.

The main girders that form the weigh bridge for the platform are constructed of 30-in. 200-lb. Bethlehem girder beams with ¾-in. plates riveted on the top and bottom to increase the section modulus. These girders carry 12-in., 28.5-lb. I-beams placed transversely to form the platform. (It is on this platform that the individual scales are placed to obtain the wheel loads.) The deck is composed of a ½-in. steel plate riveted to the I-beams.

The suspension pendulums that carry the weigh bridge upon the lever system are adjustable. The bearing and rocker blocks are made of steel castings and distribute the load uniformly over the entire knife edges.

Individual Wheel Scales

The individual wheel scales were designed and constructed more substantially than the ones previously used in obtaining individual wheel weights. The entire frame work, with the exception of the levers, knife edges, bearing blocks, and a few minor parts, is of structural steel.

Each individual scale, although weighing 2,310 lb., can be moved about easily on two rollers or wheels which can be lowered or raised clear of the floor by means of a lever and screw device. These wheels run on roller bearings and enable the scales to be handled with remarkable rapidity.

Each individual scale is so placed that one knife edge is directly under a wheel of the locomotive. Over this knife edge there is a small bearing block which is placed under the tread of the wheel by planing off one side of the rail head flush with the web. This bearing block distributes the load over a knife edge of sufficient length to limit the lineal pressure under full load to 7,000 lb. per in.

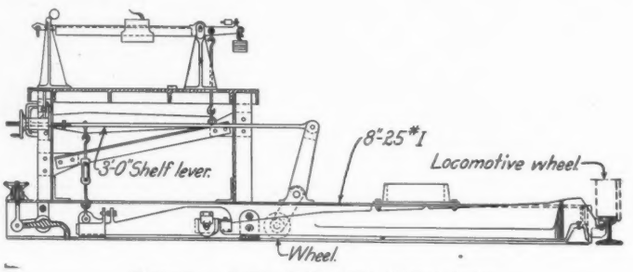
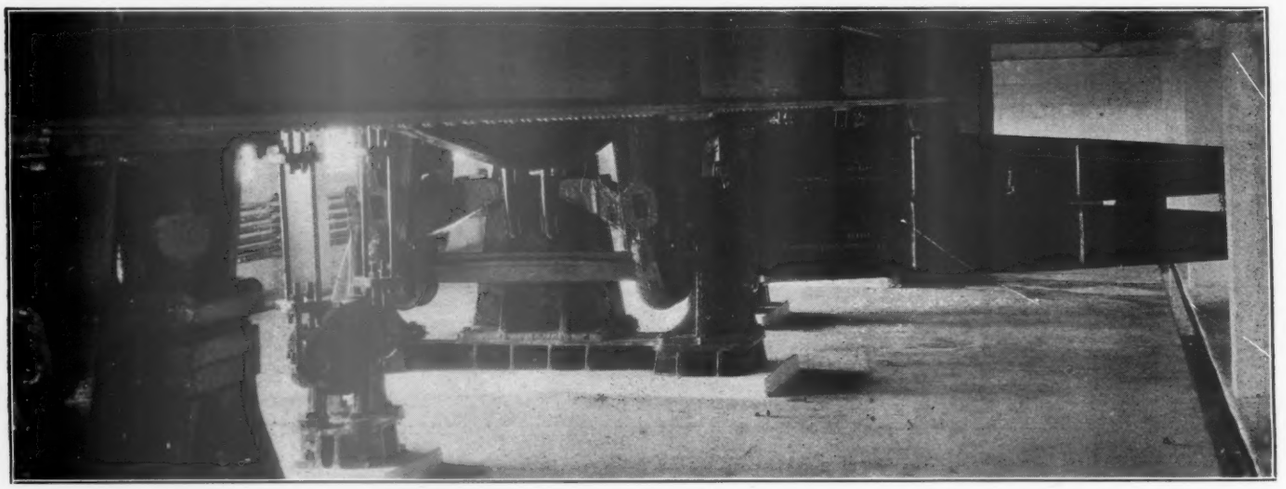


Diagram of the Individual Wheel Scale

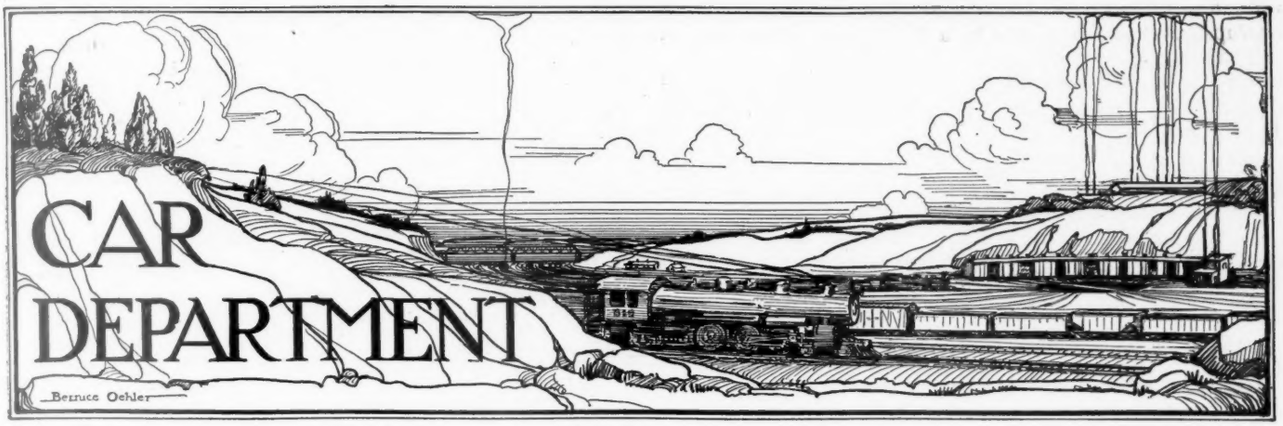
The locomotive wheel must be raised clear of the track before the weight can be registered on the weigh beam. To accomplish this, jacks which are raised and lowered by means of ratchets, have been placed on each side of the 8-in. I-beams which form the frame work for the scale. In order that the individual scales may be in alinement at all times, a small level has been placed on the shelf directly under the weigh beam. The capacity of an individual scale is 49,000 lb., increased by an additional 1,000 lb. by 10 lb. on an auxiliary beam, thus giving a total weighing capacity of 50,000 lb. An idea of the accuracy of the wheel scales was obtained in recent tests in which the sum of the wheel loads obtained with the individual scales varied only one-half per cent from the total weight recorded by the platform scales.



View of the Scale Mechanism on the Lower Level

The equipment is housed in a building of hollow tile and steel construction, 122 ft. long by 42 ft. wide. The foundations are of concrete, with a concrete mat 110 ft. long, 11 ft. wide and 3 ft. deep, reinforced with 100 lb. rail. In this mat were placed 15-in. 42-lb. I-beams to which the foundation bolts were anchored.

Designs for the scale and the installation of the equipment were worked out and built under the direction of W. N. Haines and D. L. Daly of the Standard Scale & Supply Co., Pittsburgh, Pa., and B. T. Converse and the writer, of the Baldwin Locomotive Works.



Repairing Steel Cars in a Remodeled Roundhouse

N. Y., N. H. & H. Secures Efficient Repair Plant with Small Expenditure for Facilities

DURING the past year, probably more than ever before, the officers of the railroads have been confronted with the difficult problem of improving the economy of operation with a very meagre expenditure for new equipment. In many cases it has required a high degree of resourcefulness to transform unsuitable facilities into efficient shops, but it is just such measures that enabled the roads to move the heavy traffic of last fall and that will make it possible to reduce the accumulation of bad order cars as they are once again required for service. There have been many emergency shops fitted out during the past year that have given more or less satisfactory results. The purpose of this article is to describe a plant that was pressed into service by the New Haven for repairing cars, which, by careful attention to details, was brought to a standard of efficiency that compares favorably with many shops built expressly for that purpose.

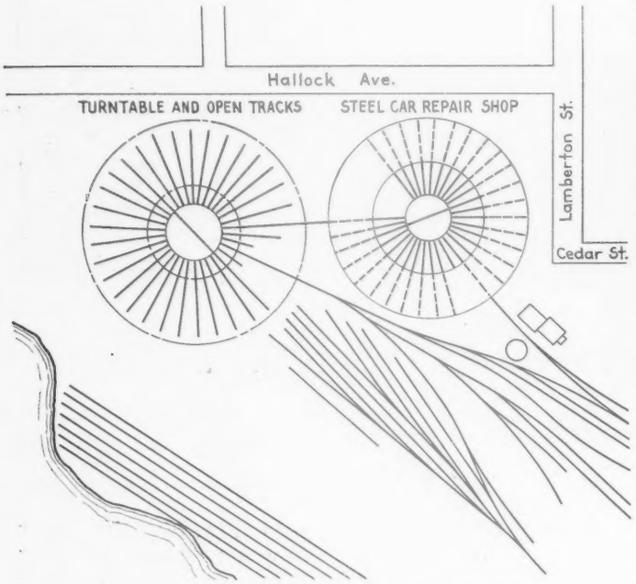
At the termination of federal control, the New York, New Haven and Hartford, in common with practically all other roads, received from connections a great many cars that had been off the home line for a long time and needed extensive repairs. This situation made it necessary to provide additional shop facilities at New Haven, especially for repairing steel cars. A short time previous the road had placed in operation the new Cedar Hill freight terminal. As a result the Lamberton Street roundhouse, adjacent to the passenger terminal and shops, was no longer in use. It was decided, therefore, to equip the roundhouse for repairing steel cars.

A General View of the Machine Department

The layout of the roundhouse and adjacent tracks is shown in the drawing. It will be noted that the roundhouse consists of a full circle, 29 pits with two tracks leading to the turntable. One of these tracks leads directly to the yard,

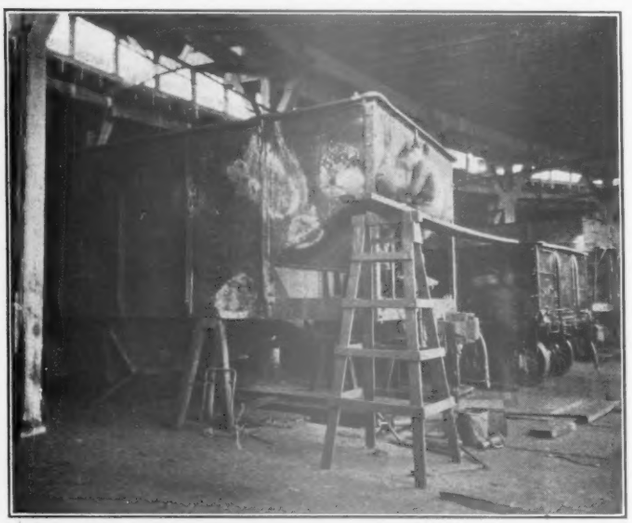
while the other goes to an outside turntable serving open storage tracks and having a separate track to the yard.

The roundhouse itself is a substantial structure with brick walls and wooden columns and roof timbers. Both the inside and outside walls had a reasonably large window area



Arrangement of Tracks Serving the Car Shop

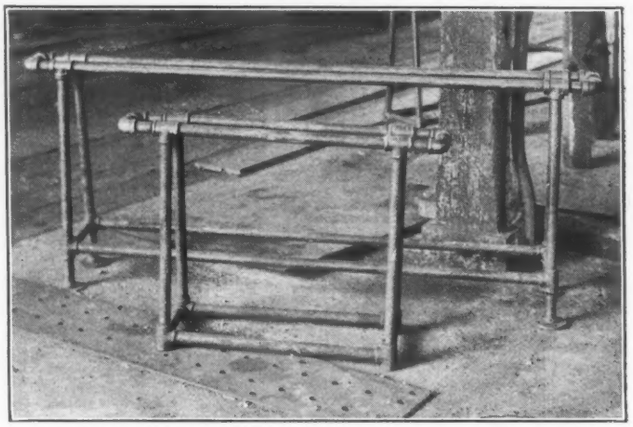
and additional natural light was furnished by a monitor in the roof. In order to make the building more suitable for repair work, the interior was first whitewashed and the pits were boarded over. Electric lights were installed on the columns and steam heating pipes were placed on the outer wall. Compressed air lines were also run around the outer wall



The Spacing of Tracks Provides Ample Room Even at the Inside Wall of the Shop

and outlets were brought to the columns between the pits. A connection was made to the air supply main from the power house and a compressor and boilers were also installed adjacent to the inner wall to insure an ample supply of air. Fuel oil piping was also installed. This is connected direct to stationary rivet heaters located at convenient points in the house and in addition supplies oil for eight portable heaters. As it was planned to utilize oxy-acetylene torches to a large extent, especially for dismantling the cars, both these gases were piped throughout the shop.

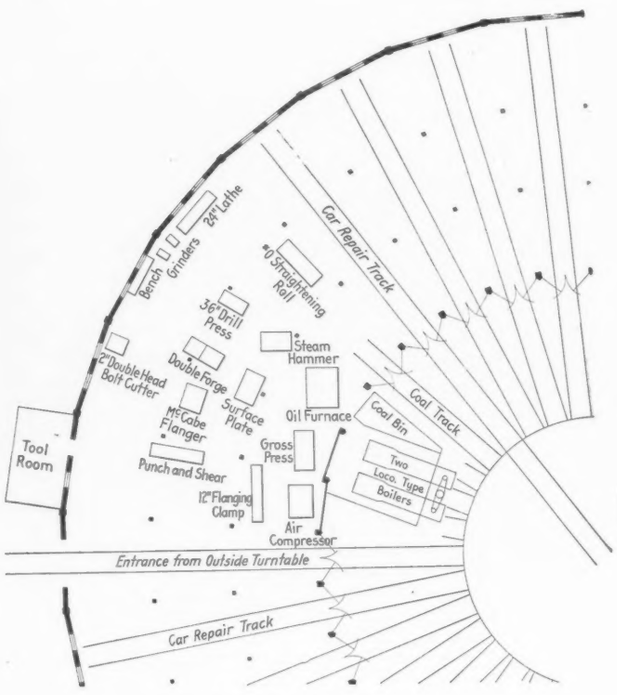
Local conditions made it most convenient to bring the cars into the house over the outside turntable and the general method of operation was planned with this in mind. On one side of the incoming track a space of four pits was arranged for the shop machinery. On the opposite side of the track seven pits were set aside for stripping. The remainder



Horses Made of Pipe Combine Lightness and Strength

of the tracks are used for assembling the cars. The larger material used in the shop, such as pressed sheets, side stakes, etc., is stored between the shop and the open turntable and one of the tracks has a platform, reached by a ramp, from which scrap can be loaded directly into a scrap car.

The tools provided in the shop were selected for their

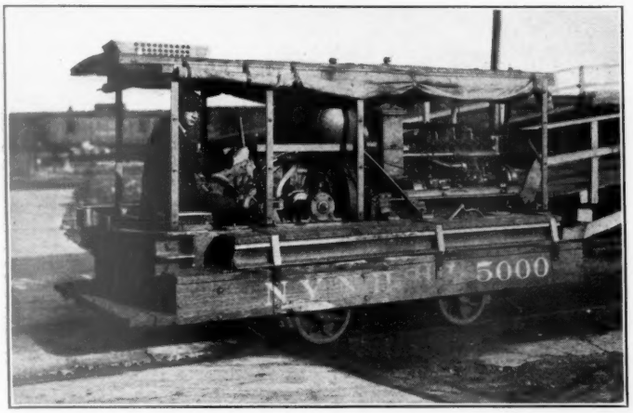


Layout of Machine Tools

adaptability in handling the wide range of work that is met in making heavy repairs to steel cars. All the large pressed steel parts standard to New Haven cars are bought from car builders and a majority of the other parts are received ready for application, so no tools for quantity production are

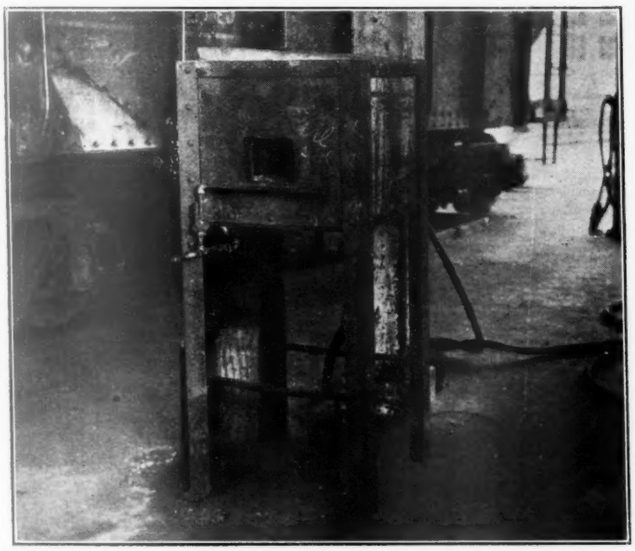
needed. Many of the smaller steel parts are made on the McCabe flanger or on a 12 ft. pneumatic clamp. Straightening is done by means of a 15 ton Gross press or on a face plate. For heating sheets or structural shapes, an 8 ft. by 12 ft. oil furnace is provided. Other equipment includes a 1,200 lb. steam hammer, a 48 in. punch and shear, two hooded forges and one large open forge, a 36 in. drill press, a lathe, bolt threader and wet and dry grinders.

The seven tracks on the opposite side of the incoming track



Gasoline Tractor Used for Switching Cars Around the Shop

comprising the stripping department, are especially equipped for this work. Air jacks mounted on wheels are provided for raising the cars and a 1,200 lb. air hoist for handling the sheets is mounted on a runway above the center line of each track. On these tracks the cars are cut down with the oxy-acetylene torch. The parts to be discarded are picked up by an electric load-carrying truck with a jib crane and are carried directly to the scrap car. As the old material is removed the new sheets are brought in by truck and are set on



Stationary Rivet Heaters Installed in the Assembling Department

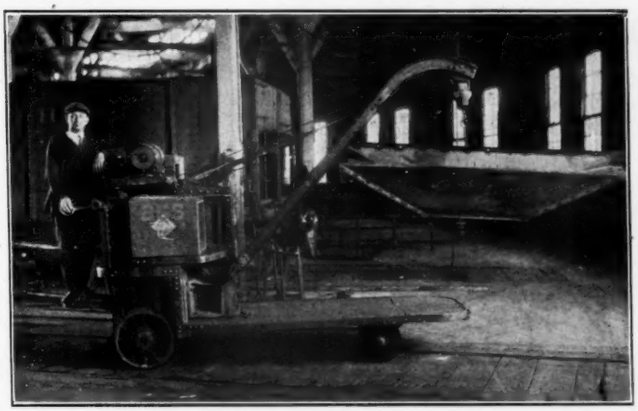
horses at the end of the car. When the stripping is finished the new parts are picked up by the air hoist and loaded onto the car, which is then switched across the turntable by a gasoline tractor and placed on one of the tracks where the assembling is done.

The practice of stripping on separate tracks and loading material onto the car before it goes to the assembling department has several advantages. It shortens the haul for the electric trucks, provides a loaded movement in both directions and keeps the assembling department clear of scrap and refuse from the dismantled cars.

The tractor used for hauling cars around the shop is so unusual that it merits special mention. It is driven by a four-cylinder gasoline engine through a variable speed friction drive. The short wheel base makes it convenient for handling cars on the turntable. By weighting the tractor down with rails the adhesion has been increased so that it is now capable of handling as many as five cars at a time.

After the cars are switched to the assembling tracks, they are raised by air jacks, the bodies are placed on horses and the trucks are run out at the ends of the car, where they are overhauled. The method of assembling the bodies differs little from general practice. All riveting is done by air hammers as a power riveter to handle the work would necessarily have a very large gap and no facilities are available for handling it.

The results obtained from the operation of the shop have been extremely satisfactory. It may be said in general that the important factors in successfully transforming the roundhouse into a steel car repair plant were careful planning of the operations and the provision of equipment which, though not elaborate, facilitates the work, eliminates unproductive



Electric Truck with Jib Crane Facilitates Material Handling

movements and avoids the condition so often found where the shop output depends primarily on the physical exertion of the employees.

Supplying Additional Information on Billing Repair Card

New instructions permitting the correction of billing repair cards in case information given on the original record of repairs has been omitted, have recently been issued by the Arbitration Committee of the Mechanical Division of the A. R. A. in circular D. V.—218. The full text of the circular is as follows:

The Arbitration Committee has had a number of questions recently relative to billing repair cards returned with exceptions, where the repairing line has supplied additional information on the repair card.

There are old arbitration decisions which prohibit the practice of supplying additional information on billing repair card and restrict the charge of the repairing road to the least expensive material or second hand material where the billing repair card did not originally show the kind of material applied.

When these decisions were rendered, the billing repair card was also the original record of repairs, being prepared at car, one copy being attached to car, one copy used for file and the original used for billing.

Since the practice of attaching billing repair cards to cars

has been discontinued (except in the case of certain private owned cars) and a form of original record of repairs has been adopted, as covered in Interchange Rule No. 7, the Arbitration Decisions referred to are abrogated.

In cases where, through oversight of clerks, the billing repair card is incomplete, correct reference may be supplied provided the original record of repairs is clear as to repairs made and material used. The original record will be subject to review by the car owner in case of dispute.

Billing repair cards should show actual conditions and check with the original record of repairs insofar as they should check.

Clerks preparing billing repair cards should not assume any information required by the Rules of Interchange which is not clearly shown on the original record of repairs.

Suggestions for Passenger Car Design

BY GEORGE S. CLOUSER

The present designs of railroad passenger cars seem to be objectionable from the standpoint of economy. This applies to more than the high first cost; they are objectionable on account of the lack of comfort that is often to be observed in the heaviest and presumably most costly of our cars. With the present trend toward lower prices, it is idle for the railroad managements to say that the demand is constantly for more and more costly service; if an earnest attempt were made to provide less costly service that had the prime requisite of railroad service; i. e., getting the people there when they want to go, and, if rates were brought down, the traveling public would be better satisfied.

A mistake made by one of our eastern roads that caused it to lose passenger traffic is to have the seats in its passenger cars too near together. This seems to be a very small matter, but it is sufficient to deter many people from traveling on this road. The cars are otherwise very nice; they look good both inside and out, they are well heated, the windows open wide, they are kept clean, the trains run fast, but the seats are too near together. This road is not saving any money by the close spacing of seats. If the cars were light in weight, one might assume it was done to economize. Actually the weight per passenger is very high.

Another mistake made is in not providing enough standing room. Nowhere in the settled parts of the country are the passenger trains able always to take care of the people that offer themselves for passage and give them all a seat. The ordinary day coach takes no cognizance of this fact, it is made to sit down in and the people who stand are utterly neglected. The present aisles are too narrow in relation to the rest of the car; the windows are set too low, and there is nothing to hold on to. For this reason the people crowd the platforms as soon as the seats are full so that the total capacity of a day coach seating 80 people is only about 100, or about the same as a trolley car of half the seating capacity. The way to remedy this condition is either to always have enough cars to handle the crowd, or provide standing room.

For short haul travel the arm rests at the aisle side of the seat might as well be omitted. The space saved by cutting down the width of the seats would, of course, go into extra aisle width, and the extra aisle width means more standing room. The question of handholds requires some consideration. Straps might do in the case of suburban traffic, but grab handles on the edge of the seat-back seem more desirable.

At the ends of passenger coaches there is usually a separate compartment seating four people. If the wall between it and the rest of the car were omitted, the car would be more roomy. To carry this particular argument to its extreme conclusion, leaving out the wall between the vestibule and the rest of the car, as far as possible, would be to still more advantage. At the same time a door should be provided at the end of the vestibule. With the maximum of clear space provided in this manner the cars would look much roomier, would have a much greater maximum capacity, and would empty and fill rather more quickly.

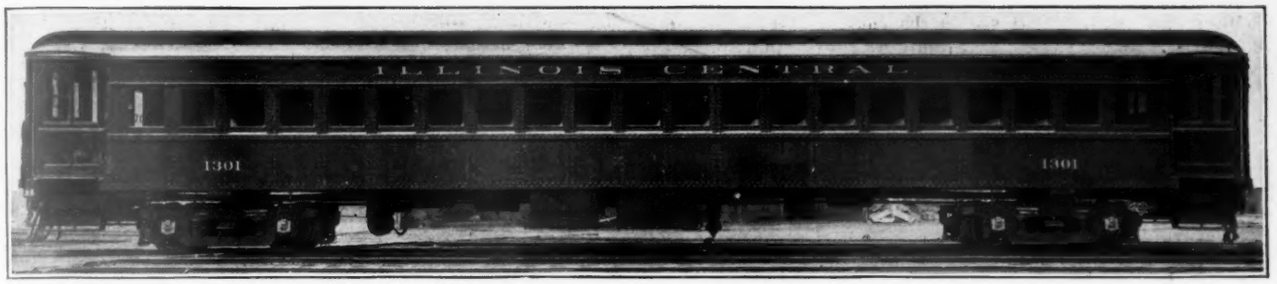
There are usually several seats at the ends of each car that have vertical backs instead of the inclined backs that are applied to the other seats in the car. Each of these seats is a cause for dissatisfaction. It should be worth while to consider giving these seat backs the same slope as the others, adding a little to the distance between uprights at these points if needed. Many of our railroads have cars with windows that open only part way. These windows are very inconvenient. They make the cars hot and stuffy and it is difficult to get a good view of the scenery. Even the Pullman company does not make all the provision it should for the comfort of passengers. With the general aspect of luxury in the cars it is remarkable that the parlor cars are not comfortable, except for a person below the average height. The seats are too straight backed and are not high enough from the floor. I make no comment on sleepers; that ground has been often covered.

For suburban service another method of increasing capacity presents itself, which is to make the seats just a little wider and to seat three. By saving on the thickness of the walls and leaving off the arm rests, this might be done on both sides, increasing the seating capacity by 50 per cent. By just taking a little off one side and adding it to the other, the seats on the one side could be made to seat three, an increase of 25 per cent, which would make eight cars do what ten cars did before.

As has been pointed out in the *Railway Mechanical Engineer,* the present designs of railroad cars seem too heavy for the service rendered. The street railroad people woke up to the same condition in their business many years ago. They figured that it cost them $50 a year to carry a ton of car around the streets and have since made considerable efforts to make one ton do what two tons did before. The steam railroads might well profit by their example. A general lightening all over seems possible.

In the earlier days of the car lighting art, when only a few cars were electric lighted, it was necessary to equip cars with storage batteries, the only alternative being to keep electric lighted cars segregated and run them in solid trains. Now that a great proportion are so lighted, the time has come when the storage battery and the axle generator may be eliminated, and the cars wired to take current from the engine. All locomotives are equipped today with generators and it would be no great trouble to equip the terminals with wiring so that cars could be lighted while waiting for engines. The generator needed for lighting a train would probably deliver the light for no greater expenditure of fuel than the present round-about way through the main engine, axle generator and storage battery, or even the direct method of storage batteries alone. Certainly the investment would be less, also the upkeep, and there would be a considerable decrease in the total weight to be carried around with a corresponding decrease in cost. Such train lighting equipment is already on the market. If the managements could get together and agree on standard voltage and couplings, the cars would be interchangeable the country over.

For many years the statement has been made that the public demands ever more and more costly service. Today the public demands cheaper service. In the past the railroads have added heavier and heavier cars to their trains without a corresponding increase in capacity, with the result that heavier and heavier engines are needed. By judicious design of passenger cars, it should be possible to cut down many of the items of expense that enter into the total cost of transportation, and even to speed up some of the trains in place of the lengthening of the running time that we have seen take place so often in the last few years.

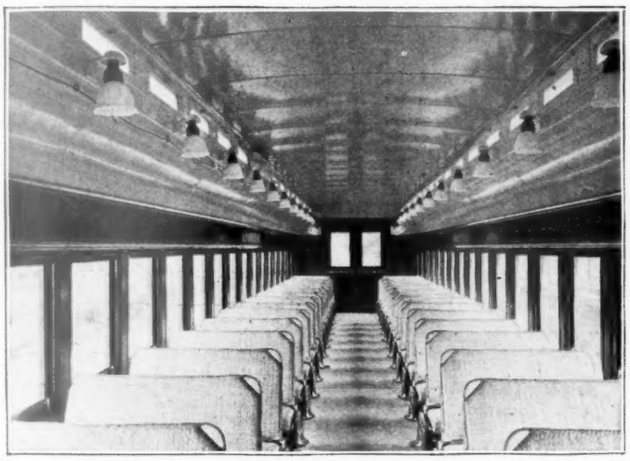


Illinois Central Suburban Cars, Adapted for Electric Operation

Illinois Central Steel Suburban Coaches

Designed for Future Electrification; Doors Electrically Controlled; Total Weight 92,100 lb.

THE Illinois Central has recently received from the Pullman Company 20 new steel suburban coaches, which have been placed in service in Chicago, the design of which has been influenced in numerous details by the prospective electrification of this road within the Chicago terminal district. The cars are completely equipped for steam train service, in which they are now operating, and have been designed primarily for trailer service after electrification has been completed, although the car bodies are of sufficient strength to be equipped with motor trucks, and other electrical apparatus, should this later seem desirable. The weight of the cars equipped for steam operation is about 92,100 lb.



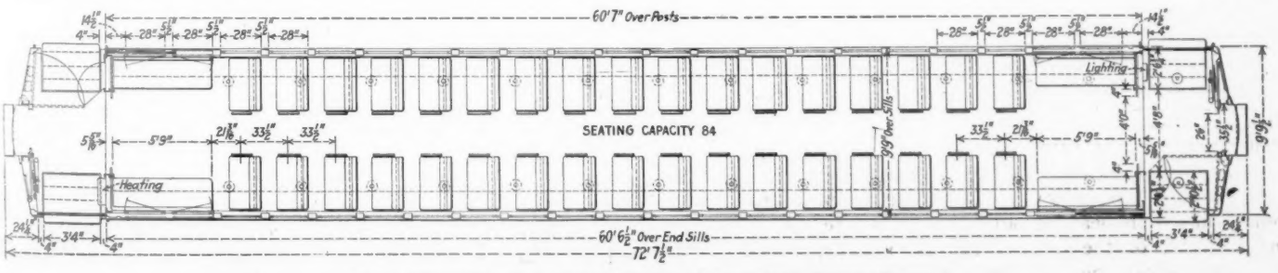
Interior View, Showing Open-End Seats

At present the cars are equipped with steam heat and with axle generator and battery equipment for electric lighting; this equipment in both cases follows the standard of the road for passenger coaches in main line service. The conversion for electric service will consist of the substitution of electric heaters for the present steam heat equipment and the removal of the axle generator equipment, the current for lighting then being obtained from the power source. The vestibules have been arranged to facilitate the installation of multiple unit control apparatus, brake valve, gages, etc., and with this in view the hand brake staff and handle have been placed on the left side instead of the right side of the vestibule platform.

The cars have a coupled length overall of 72 ft. 2 in. and are 60 ft. 6½ in. long over the body end sills. A seating capacity of 84 is provided for by 17 transverse seats on either side of the car and four longitudinal seats 4 ft. 9 in. long, one on either side at each end of the car. Sliding doors are used throughout. Those at the ends of the seating compartment close from either side toward the center, while the end and side vestibule doors are each single units, the former opening toward the left while the latter slide back into the side walls of the car body. The end doors of the car and the vestibule side doors provide a clear opening of 4 ft. in each case, while the vestibule trap doors are 3 ft. 4 in. in width. The floor plan shows the proposed arrangement of the control apparatus for electric operation and the way in which the right side of the vestibule will be closed off to form the motorman's compartment.

In working out the seating arrangement, particular attention has been given to provide ample room between the seats and ample height of back for the comfort of passengers. No ends are provided on the seats, in order that the passengers may enter quickly and leave them quickly and conveniently. The width of the aisle at the seat end is about 31 in., increasing to 36 in. at the edges of the seat backs. This width is considered ample to permit two persons moving in opposite directions to pass in the aisle without difficulty.

The interior finish is steel throughout, with the exception



Floor Plan, Showing Provision for Motorman's Compartment

of the single sash, which are of mahogany. Above the side lights the finish is in white, including the fixtures. The sides and the seat ends are finished in mahogany color.

Details of Construction

With the exception of the longitudinal sills and a few details of the vestibule ceiling construction, the frame members are practically all of pressed steel.

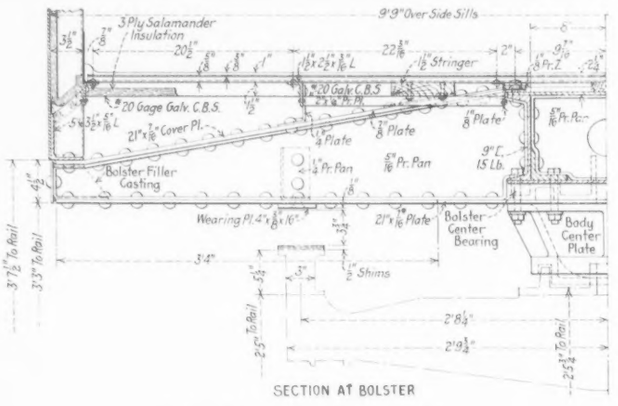
The center sills are 9-in., 15-lb. channels placed back to back 16 in. apart. At the bottom they are reinforced with 4-in. by 3-in. by ½-in. angles, the long flanges of which project toward the center of the car. These sills are 69 ft. 3 in. long and at the ends are framed into steel buffer castings. At the top they are reinforced with a ¼-in. plate 21 in. wide and 64 ft. 8½ in. long. Bottom cover plates of the same dimensions, each 8 ft. 5⅛ in. long, extend towards the ends of the car from points about 2 ft. 6 in. inside of the center line of the body bolster.

The lateral members of the underframe are all pressed steel pan sections. The bolster is formed of two of these sections of 5/16-in. material with flanges 3 in. deep, spaced 10 in. back to back with fillers between the center sills. They are finished with top and bottom cover plates of 7/16-in. material, 21 in. in width, which extend continuously from side sill to side sill. A filler casting below the center sills brings the lower face of the bolster 2½ in. below the bottom of the sills. The lower face of the bolster is horizontal while the top tapers from a depth 12 3/16 in. over the center sills to a depth of 4½ in. at the sides of the car. This brings the ends of the bolsters directly under the ⅝-in. by 3½-in. side sills.

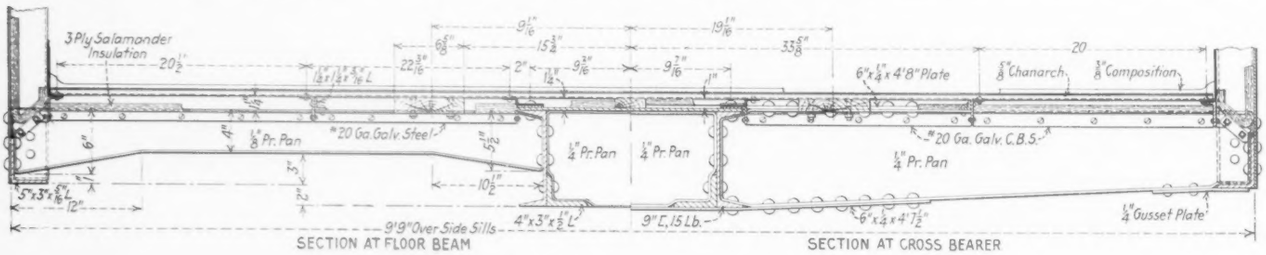
There are two cross bearers, each 7 ft. 4½ in. from the transverse center line of the car. These are each made up of three single pressings of ¼-in. material, one on either side of and one between the center sills. The three units are joined with ¼-in. top and bottom tie plates about 48 in. long. The floor beams, one of which is provided at each vertical frame member, are of ⅛-in. material.

Longitudinal stringers of 2½-in. by 1½-in. by 3/16-in. angle section are placed over the floor beams, one on each side of the car 33⅝ in. from the center line. The rectangular openings between the longitudinal and transverse members are closed with flanged sheets of No. 20 galvanized steel, painted, the flanges of which are secured to the frame members with ¼-in. stove bolts. At the sides these sheets are bolted to the vertical flanges of 2½-in. by 1½-in. by 3/16-in. angle floor supports riveted to the inside faces of the side posts.

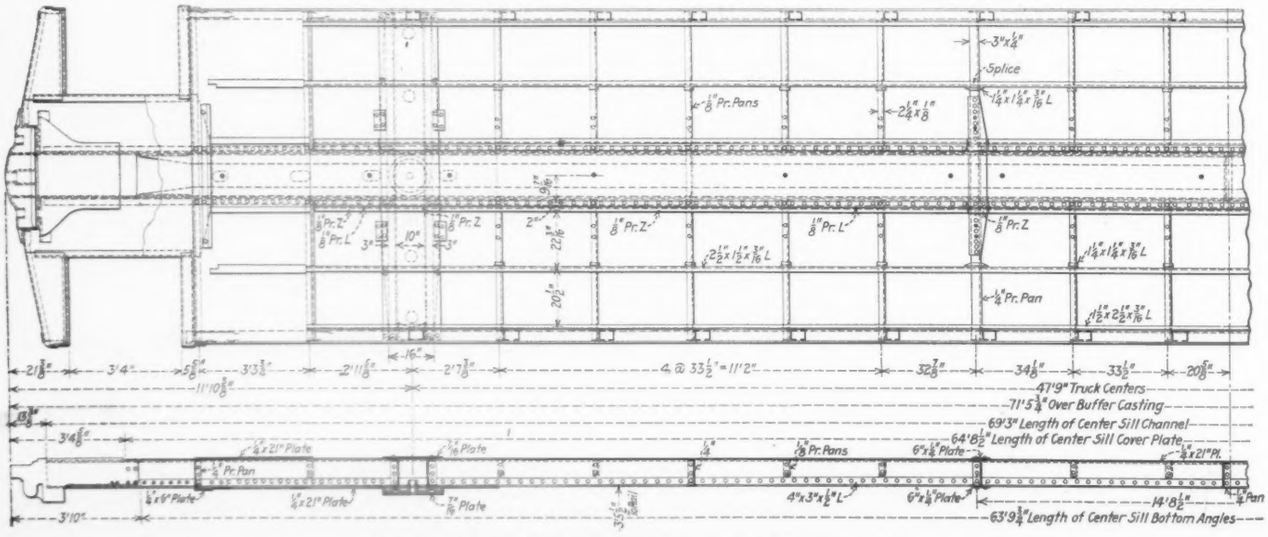
The vertical members of the side frame are double channel sections arranged to form posts 5½ in. deep by 3½ in. in transverse width. These posts are framed into the angle side



Underframe Section at Bolster



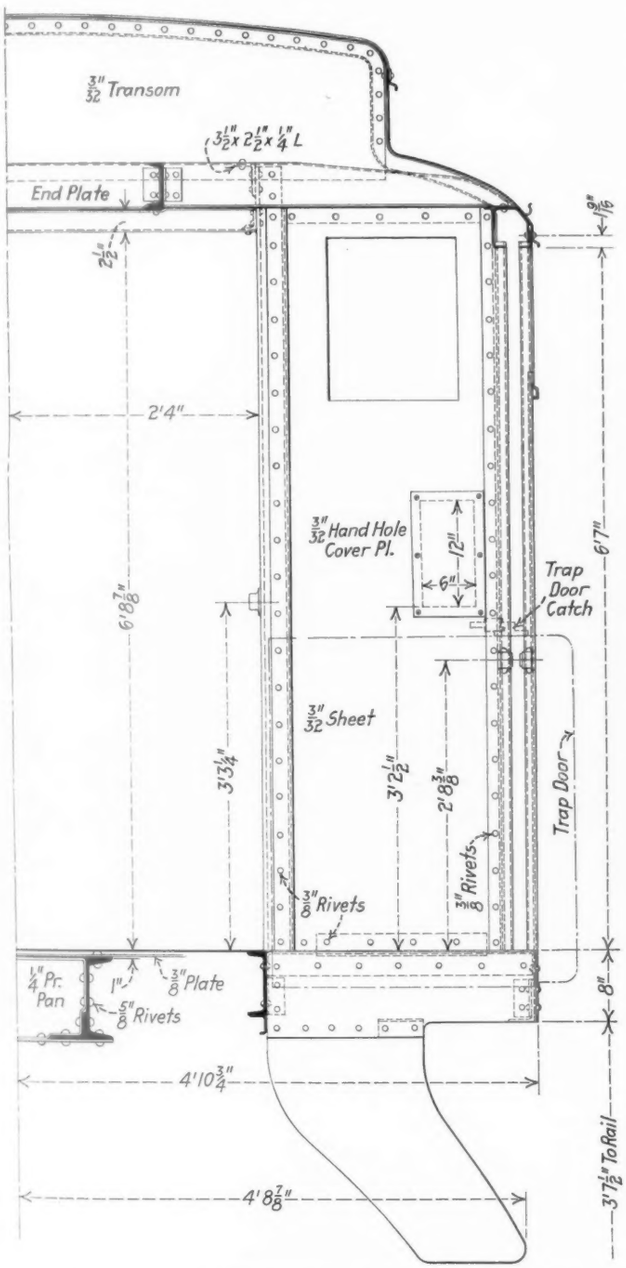
Transverse Sections of Underframe at Floor Beam and Cross Bearer


3"x¼" Splice
47'9" Truck Centers
71'5¾" Over Buffer Casting
69'3" Length of Center Sill Channel
64'8½" Length of Center Sill Cover Plate
63'9¾" Length of Center Sill Bottom Angles

Underframe Design—Illinois Central Suburban Coaches

sills at the bottom and into side plates of special pressed section at the top. The carlines are of flanged channel section, the ends resting directly on the side plates.

The outside of the car is finished with ⅛-in. girder plates and a 4-in. by ½-in. belt rail below the windows. The pressed steel sash rests of ⅛-in. material are placed between the side posts, which are located 2 ft. 9½ in. between centers. The sash rests are 29¾ in. above the floor and are



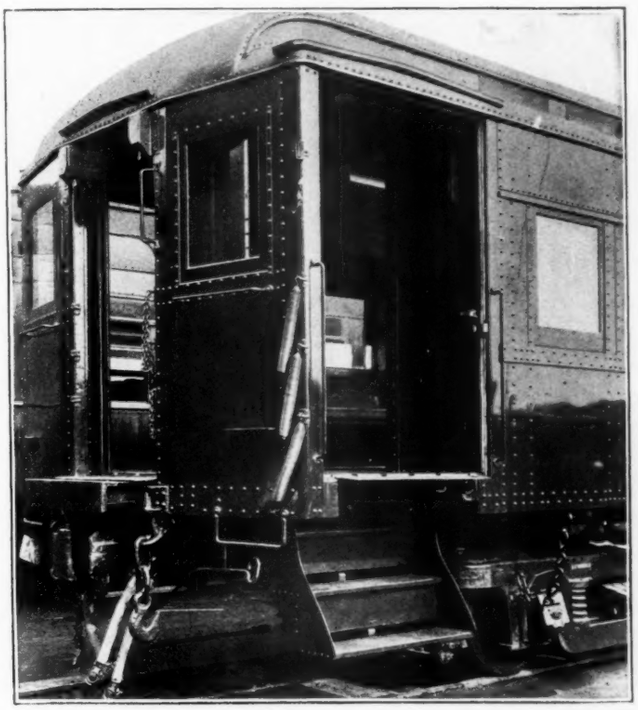
Details of Vestibule Framing of Illinois Central Steel Suburban Coaches

formed so that the outer flanges are flush with the outside girder plates. The belt rail forms a splice for the sash rests and the side girder plate. Above the windows the sides of the car are closed on the outside by a letter board about 18 in. in width.

The principal members of the vestibule construction are 6-in. channel vestibule end posts of ½-in. pressed steel, 4-in. channel body door posts of the same material and body end posts of 5-in., 6.7-lb. channel section secured to the inside of the side construction. The lower ends of the vestibule end posts are framed into the steel buffer casting and at the top are secured to the ends of 5-in., 6.7-lb. channels extending longitudinally just above the vestibule ceiling to the bulkhead at the end of the car body. These channels are spaced 17¾ in. on either side of the longitudinal center line of the car while the faces of the body door posts are 2 ft. 4 in. on either side of the center line. The inner ends of the longitudinal channels and the upper ends of the body door posts are secured by corner plates to a transverse member of pressed steel which in effect forms a deep box girder across the car at this point. Other details of the vestibule construction are shown on one of the drawings and the photograph below.

The car body is insulated with three-ply insulation throughout, laid against the outside of the body walls. The floor is finished with ⅜ in. of composition material laid on corrugated pressed steel supports.

The cars are carried on four wheel trucks with cast steel



Air-Operated Sliding Doors Are a Feature of the Vestibule Design

frames and the usual type of equalizing arrangement, fitted with 33-in. rolled steel wheels mounted on axles with 5-in. by 9-in. journals. The pedestals are cast integral with the truck frames. The bolsters are of cast steel and are fitted with roller side bearings and separate center plates, the interior surfaces of which are finished and fitted with finished bronze liners. The trucks have clasp brakes.

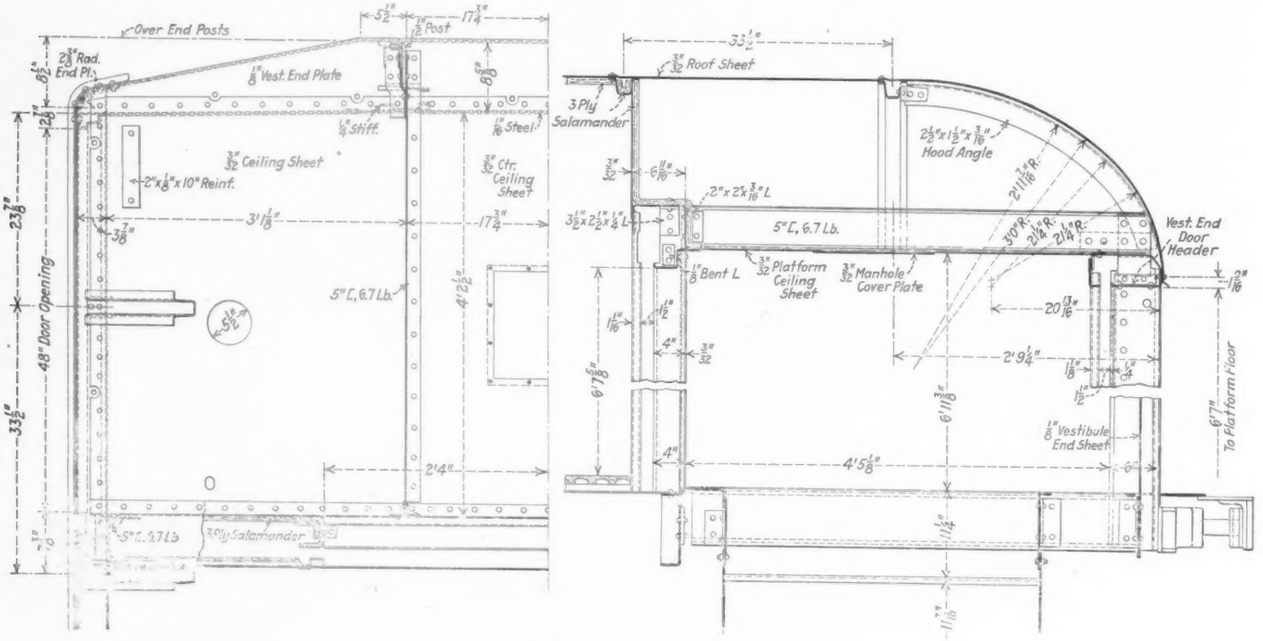
The trucks are fitted with a device for adjusting the coupler height by raising the spring plank, shown in sections on the truck drawing. The device consists of a spring plank hanger pin or yoke provided with four bearing faces the radial heights of which are progressively increased. Progressive adjustments are made by turning these pins or yokes to bring the next higher space under the spring plank and substituting filler blocks with flanges of suitable depth

Door Operating Mechanism

All doors on these cars are of steel construction. The double doors at the ends of the car body are geared so that

they operate together. They are arranged to lock both in the open and closed position.

The vestibule side doors are operated by air engines, one for each door, taking air from a reservoir under the car main-

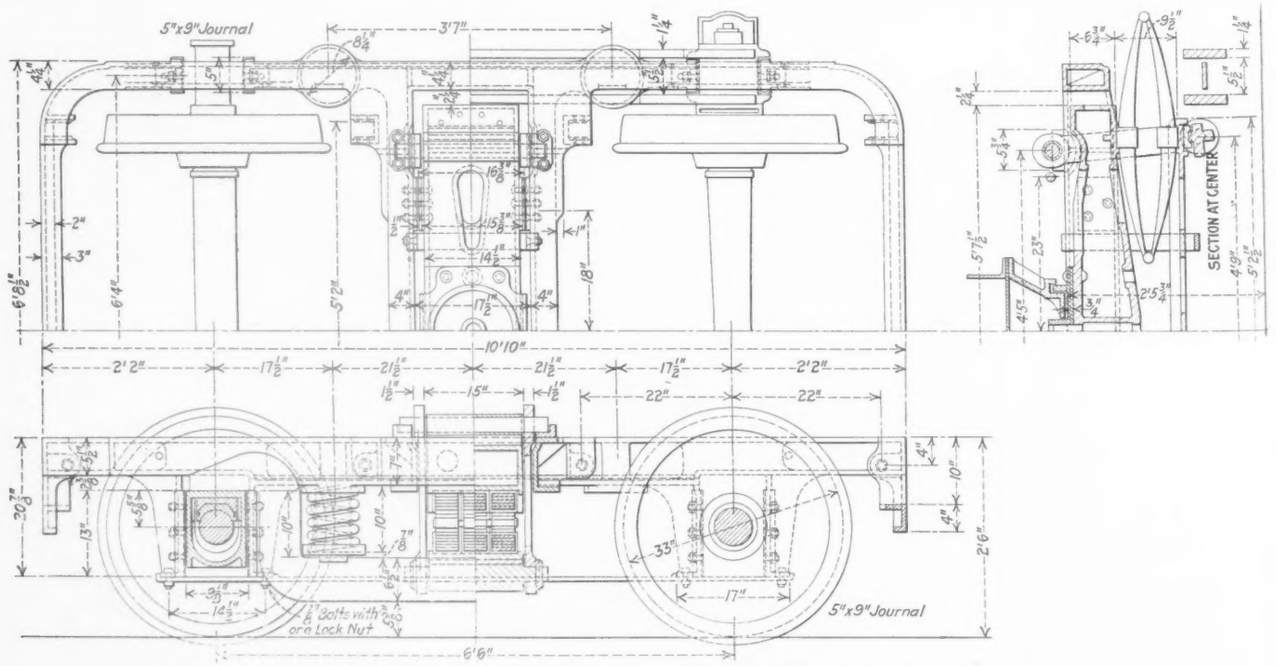


Sections Through Vestibule

tained at main reservoir pressure by direct connection with the locomotive. Each end of the car is fitted with one of these reservoirs which has sufficient storage capacity to permit the operation of the doors 10 or 12 times after the locomotive

The door operating engines are located under the longitudinal seats at the ends of the car. The operation of the air valves of this mechanism is electrically controlled by double lever switches which are mounted in cast iron boxes, se-

cured to the outer faces of the vestibule door posts at both ends of the car. There are two levers, both arranged to lock in the neutral position, one for opening and closing the door and one neutral. As a further safety feature there

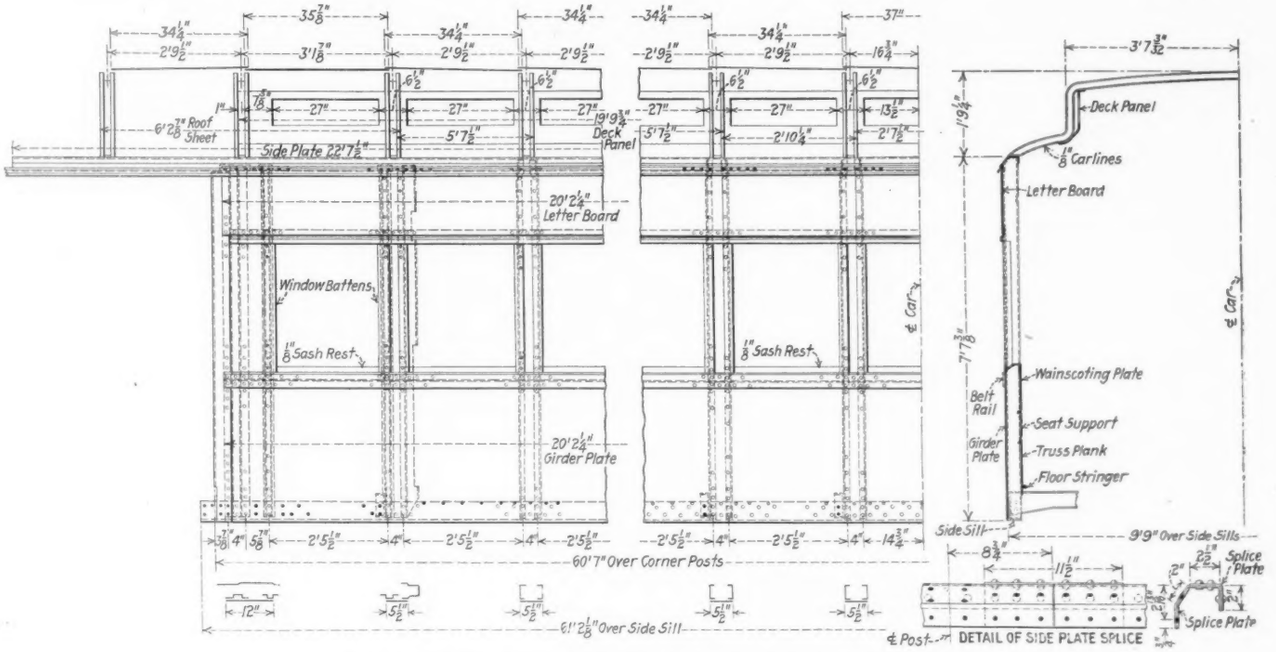


Cast Steel Truck Under Illinois Central Suburban Coaches

has been cut off. These reservoirs are directly connected to the main reservoir of the locomotive by a ¾-in. train line. No signal air line is provided as automatic electric signals are used in suburban service.

is a collapsible arm on the engine shaft so that the door can be opened about 6 in. from its closed position. Each switch box controls both of the doors on one side of the coach, an arrangement which permits one guard to operate all of the

doors on two cars. In event of an electrical failure the air valve may be operated by hand. In case a door is closed on an obstruction which prevents further movement it automatically opens about 36 in., then reverses and moves towards the closed position again. This movement is kept up by the closing of the doors. A green light mounted in the cab of the locomotive is connected to a series circuit carried back through the train by electrical connectors between the cars. This circuit is broken by the opening of any vestibule side door in the train and is closed only when all of the



Side Frame Construction of Illinois Central Suburban Coaches

automatically until the obstruction is removed. An electric contact mounted on the edge of the door and protected by a flexible rubber casing, causes this action.

A feature of considerable interest in connection with steam operation is an electric starting signal operated automatically doors are closed. Closing the doors thus causes the lighting of the green lamp in the locomotive cab, which serves as a starting signal following station stops. The circuit for the automatic starting signal receives its energy from the headlight generator of the locomotive.

The Requirements for a Modern Car Repair Shop

Type of Building, Character of Tools and General Plan for Both Steel and Wood Equipment

BY H. H. DICKINSON AND PAUL SCHIOLER
The Arnold Company, Chicago

THE inadequacy of facilities for the repair and maintenance of cars creates one of the most important problems which now confronts the executives of American railways. The enormous amount of capital tied up unprofitably in bad order cars is already a serious matter in railway economics and is growing worse through the increased unit costs of rolling stock. Furthermore, during repeated periods in more recent years, every railroad has been seriously hampered in its operations because the facilities for car repairs have not kept pace with the increase in the amount of equipment.

In planning a modern car repair shop the main points of consideration are the location, the site, the type, size and number of buildings, and the equipment, i. e., cranes, machinery, power, etc. Location and site are matters of local determination but in the selection and grouping of buildings and their equipment with apparatus, labor saving devices and machinery, certain specific recommendations and suggestions may be made.

The work of repairing railway cars falls naturally in two main divisions; wooden cars and steel cars, with the intermediate one of cars with steel underframes and wooden tops. For wood car repairs frame buildings will usually answer the purpose in a satisfactory manner. It is true that they are not fireproof, but this does not add to the fire hazard from within, as the contents of such a shop are inflammable anyway, and the custom of supporting the roof in mill buildings on intermediate columns will, in fact, make them more desirable in this respect than steel truss buildings as steel trusses collapse promptly under an inside fire. If it is desired to protect against fire danger from adjacent lumber yards, storehouses, etc., a fireproof roof covering may readily be provided.

The saw and planing mill operations involved in the

preparation of material for wood car repairs are in reality a separate industry from car repairing. The following list of machinery is recommended for the average requirements:

1—four-cylinder sill and timber dresser, motor driven.
1—double-cylinder surfacer, motor driven.
1—planer and matcher, motor driven.
1—24-in. rip saw table, motor driven.
1—16-in. rip saw table, motor driven.
1—36-in. swing cut-off saw, motor driven.
1—24-in. cut-off saw table, motor driven.
1—vertical boring and mortising machine, motor driven.
1—car gainer, motor driven.
1—12-in. mitre saw table, motor driven.
1—24-in. jointer, motor driven.
1—48-in. band saw table, motor driven.
1—saw gumming machine, belt driven.
1—vertical car tenoner, motor driven.
1—wood lathe, belt or motor.
1—three-spindle vertical and radial car borer, motor driven.
1—flexible single spindle post borer, belt driven.

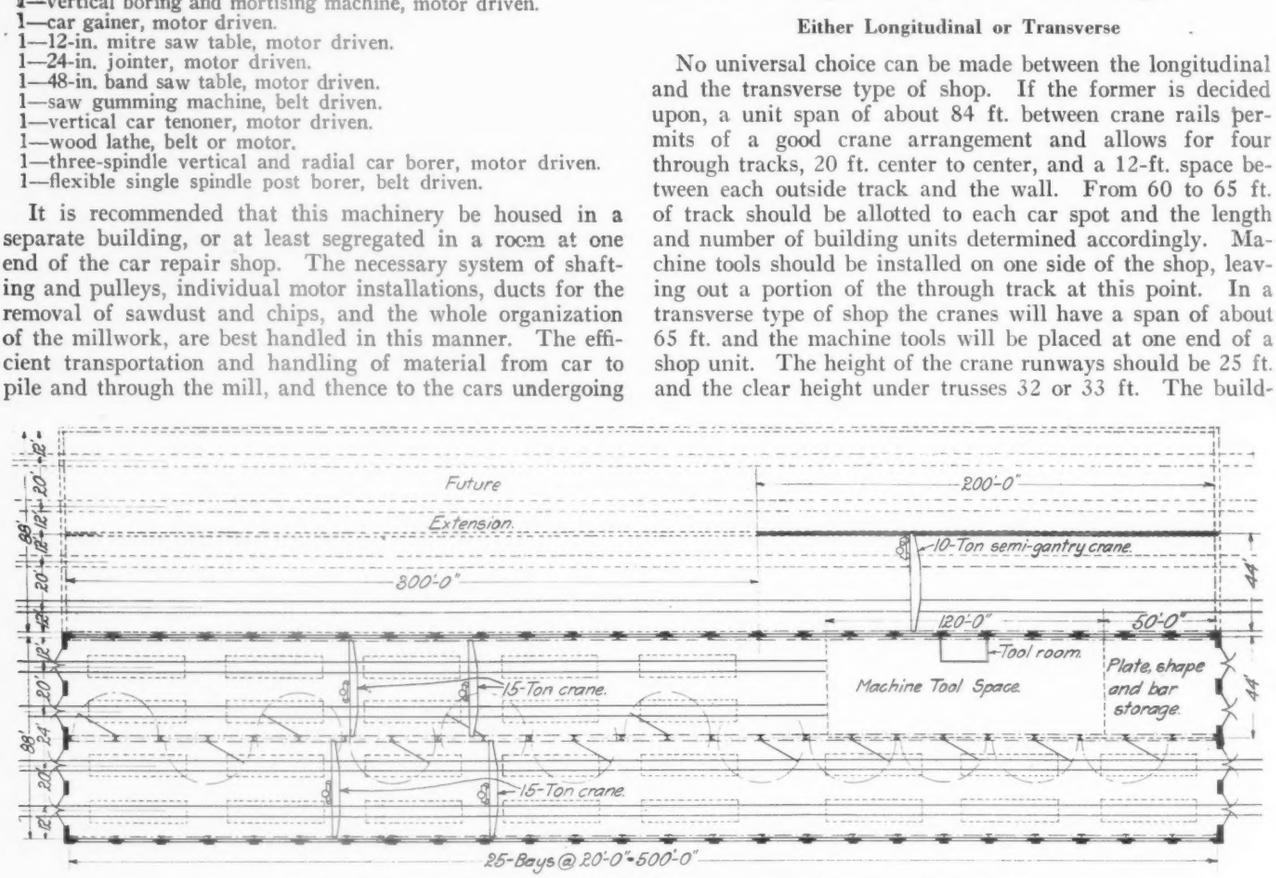
It is recommended that this machinery be housed in a separate building, or at least segregated in a room at one end of the car repair shop. The necessary system of shafting and pulleys, individual motor installations, ducts for the removal of sawdust and chips, and the whole organization of the millwork, are best handled in this manner. The efficient transportation and handling of material from car to pile and through the mill, and thence to the cars undergoing repair, is quite as important as is material handling in any industry, and it is best accomplished by properly arranged industrial tracks and yard cranes. Overhead crane service cannot be very well arranged in a mill constructed building, but for wood work only it may be dispensed with in most cases.

Work on steel cars and on cars with steel underframes as a rule compels the selection of steel frame structures, for the double reason that these are easily made fireproof throughout and they allow the proper installation of overhead crane service as well as the attachment of jib cranes in the most efficient manner. Moreover, steel trusses and steel sash, being of smaller dimensions than wood, allow a better diffusion of exterior light. Wherever climatic conditions permit, the sawtooth form of roof should be carefully considered, as it gives excellent light between cars standing on repair tracks. At any rate, the monitor sash or roof lighting should be placed crosswise over the tracks. Monitor sash should be arranged for ventilation and the side wall sash should also be provided with ventilated sections. Factrolite glass is recommended because of its superior diffusion of light and the elimination of shadows. Artificial lighting is best obtained by using tungsten lamps with enameled steel reflectors; the distribution of lamps must provide for full illumination of the spaces between cars on tracks.

The best artificial heating system is a combination of direct radiation and indirect or fan blast heating, the direct radiation to be distributed along the building walls in proper quantity to compensate for the glass area exposure, and the fan blast outlets to provide heat for the center area of the shop and to take care of the requisite air circulation. If because of the character of the ground or for other reasons, underground ducts are undesirable, individual motor-driven fan heating units may be used to advantage.

Either Longitudinal or Transverse

No universal choice can be made between the longitudinal and the transverse type of shop. If the former is decided upon, a unit span of about 84 ft. between crane rails permits of a good crane arrangement and allows for four through tracks, 20 ft. center to center, and a 12-ft. space between each outside track and the wall. From 60 to 65 ft. of track should be allotted to each car spot and the length and number of building units determined accordingly. Machine tools should be installed on one side of the shop, leaving out a portion of the through track at this point. In a transverse type of shop the cranes will have a span of about 65 ft. and the machine tools will be placed at one end of a shop unit. The height of the crane runways should be 25 ft. and the clear height under trusses 32 or 33 ft. The building should be piped for air and acetylene, a double air outlet to be provided for every car spot and an acetylene outlet for every two car spots. The building should also be wired and have a contact at each car spot for the attachment of modern electrical tools.



A Steel Car Repair Shop with a Longitudinal Arrangement in Two 44-ft. Aisles

The best flooring for car repair shops is creosoted wooden blocks on a concrete base. This is usually preferred by mechanics where nothing in the industry militates against its adoption, and in work of this nature there are no objections to this floor. It is durable, sanitary, non-conducting as to heat and cold and affords a satisfactory foothold.

Adjoining the machine tool area racks for the storage of a reasonable quantity of large sheets and plates should be provided as well as storage facilities for bars and shapes. Storing this material inside the building not only permits unloading and storage by crane and provides crane conveyance to machines without extra handling, but it also eliminates deterioration from rust and other defects occasioned by continued exposure. An important factor in the efficiency of the shop is the relative adequacy of the general stores, and it will be well to make ample provision for all materials and supplies required in overhauling all the types of cars for which the shop is intended.

To permit full use of tracks for the spotting of cars under repairs and to have the receiving and unloading of material

interfere as little as possible with the car repair work in the shop proper, it is recommended that, where possible, material be received on a track outside of the walls. In such a layout a six or eight-ton crane, supported partly by yard columns and partly by the building columns and spanning the material track, is a profitable investment and should be installed.

Repairs and overhauling of cars result in the accumulation of a large amount of sheets, plates, bars, rods, etc., all partly damaged but having considerable reclamation value. It is good economy to provide, in the machinery equipment, suitable tools, such as straighteners (plate and bar), furnaces, bulldozers, bolt threading machines and nut tapping machines, in order that salvaged material may be reclaimed on the spot and either used immediately in the shop or turned over to the stores department.

The widest possible application of crane service is advocated as the most fruitful way of securing an intensive utilization of the plant as a whole. The maximum load to be handled by cranes is usually between 25 and 35 tons, but the average load is much lighter. Two cranes of 15-ton capacity each may readily be operated together to handle a maximum load when occasion demands, and for general purposes they serve the shop better than it is possible to do when the crane capacity is concentrated in one machine of, say, 30 tons size.

It has already been stated that truss spans giving approximately 84 ft. between crane rails are desirable in longitudinal shops. For flexibility of crane service it is best to substitute for this two bays of 44 ft. each. The use of center columns should enable the designer to lighten the steel work in the roof trusses and provide good support for jib cranes. It will be less expensive to install two 42-ft. cranes and equip each one with a 15-ton hoist and an auxiliary rapid hoist of smaller capacity, than it would be to put in one crane of 84 ft. span, and they will serve the shop more efficiently. It is recommended that the lengthwise travel of cranes be limited to 300 ft., preferably about 250 ft., so that a shop unit from 500 to 600 ft. long should have at least two cranes, or sets of cranes. Jib cranes of the portable type, or attached to steel columns are an excellent means of handling work at car spots and at certain of the machine tools. They release the overhead cranes for general transportation and material handling through the whole shop. The jibs should have about a 20-ft. swinging arm and should be of at least one ton capacity.

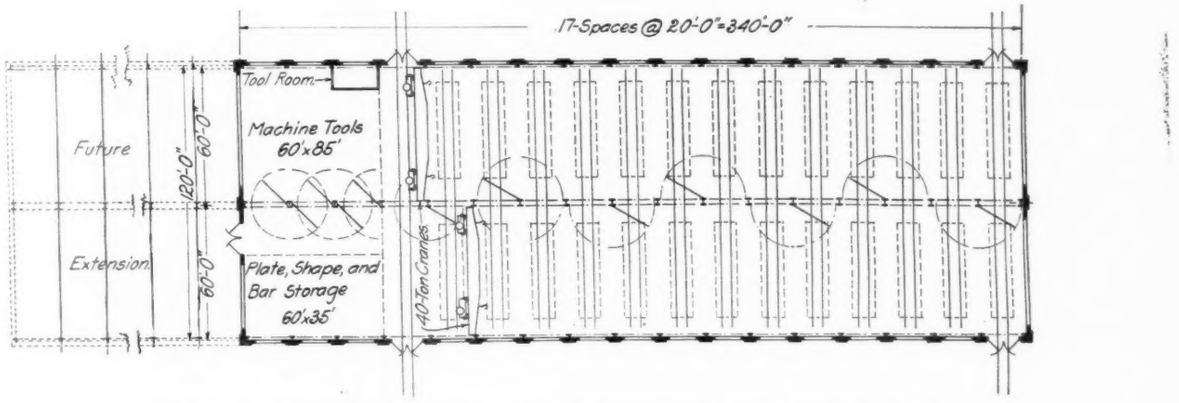
The painting in a modern car repair shop should be done by pneumatic sprays. This applies to wood and steel work alike. It may be desirable to have the plant equipped with a sand blast outfit, so that when steel cars or underframes require thorough cleaning the work may be disposed of in the most efficient manner. However, only a fraction of the cars passing through the plant will need this treatment, and unless the capacity of the plant calls for at least 20 cars per day, a sand blast equipment can hardly be installed advantageously.

The wheel and axle work must be handled by a wheel lathe, an axle lathe, a wheel press and a wheel boring machine, and if the shop is about 84 ft. by 600 ft., or its equivalent, these tools are best placed among the other machine tools and the work organized to co-ordinate with the other shop operations. If, however, the layout provides for two or more shop units, then the work on wheels and axles is best done in a separate department located adjacent to the shops and operated in conjunction with them, leaving the shops proper to handle repairs to car bodies and underframes exclusively. One wheel and axle department will, of course, serve a steel car and a wood car shop.

Tools for Steel Car Work

The following machine tool equipment is recommended for a car repair shop which is to handle the variety of types of steel cars used on the majority of railways:

One single end punch (24 in. throat), motor driven.
One double punch and shear (30 in. throat), motor driven.
One double horizontal punch and bending machine, motor driven.
One 8-ft. gate shear (cap. ¾ in. plate), motor driven.
One 6-in. by 6-in. by 1-in. angle shears, motor driven.
One alligator bar shear, motor driven.
One plate straightening press, pneumatic.
One 9-ft. by 14-ft. plate heating furnace, oil and gas burning.



Plan for a Steel Freight Car Repair Shop with a Transverse Layout, Two 60-ft. Aisles

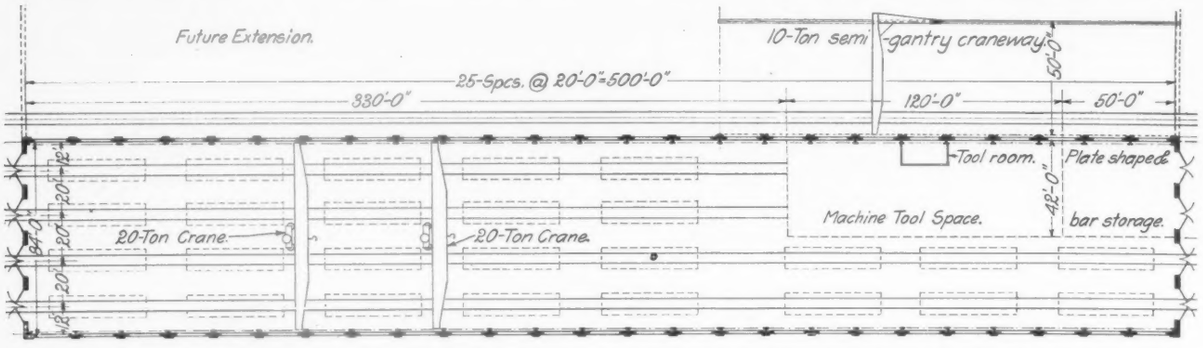
One 12-ft. flanging clamp, pneumatic.
One 7-ft. by 10-ft. plate heating furnace, oil or gas.
One heavy duty bulldozer, motor driven.
One 5-ft. by 8-ft. furnace, oil or gas.
One 2-in. bolt heading, upsetting and forging machine, motor driven.
One forging furnace, oil or gas.
One 2½-in. double head bolt cutter, motor driven.
One 300-lb. power hammer, motor driven.
One 30-in. by 3-ft. furnace, oil or gas.
One 1,000-lb. steam hammer, steam.
One 3-ft. by 4½-ft. furnace, oil or gas.
One 6-ft. radial drill, motor driven.
One 4-spindle drill press, belt driven.
One 4-ft. drill press, belt driven.
One 26-in. drill press, belt driven.
Two heavy emery wheel stands, motor driven.

This list is in addition to any tools for reclaiming materials and does not contain the wheel and axle tools referred to in a preceding paragraph. The list is necessarily empirical and must be reviewed and compared with the individual requirements of any one shop under consideration. It is manifest that when, for instance, a shop is being laid out to handle principally the repairs of one type of steel cars, some of the tools mentioned may well be omitted and several others added; indeed these notes do not repre-

sent an attempt to design in detail any one particular car repair shop.

A number of railroads have experienced considerable annoyance and suffered a large aggregate loss as a result of too frequent loss of identity of freight cars undergoing repairs. A timely reform in the operation of car repair shops would be the adoption of uniform methods of checking the number on a car brought into the shops, preserving it upon the car while it is under repairs and checking it out again, but such a reform, to have the desired effect, would have to be universal in the shops of all railroads.

When a modern car repair plant is contemplated it is almost invariably the intention to provide steady employment for a number of workmen. Therefore it is advisable to provide a service building, located as conveniently as possible to the plant entrance. This building need not be elaborate, but it should contain a requisite number of steel lockers, lavatories and toilets and also some shower baths of approved sanitary design. There should also be a room where the men can eat their lunch during cold weather.



A Steel Freight Car Repair Shop with a Longitudinal Arrangement in an 84-ft. Aisle

These suggestions and recommendations, although specific and based on examination of actual conditions on the roads and in existing shops, will only be found of value when carefully considered with all the local conditions and circumstances bearing upon the individual project of any railroad.

Thus, the question of location and site, as regards labor conditions, topography of the prospective site, climatic conditions, fire protection facilities and proximity to railway terminals from which empty cars would be received must be gone into and decided upon in every instance, and the foregoing notes must be considered with the questions of the volume and class of work, frequency and season of maximum demand, average daily requirements and desirability of provisions for future extensions.

The three typical layouts shown embody some of the general desirable features mentioned. They are, of course, not intended to serve even as finished sketches of any one specific project, but they may form a basis for study and discussion and a nucleus around which layouts may be developed for particular conditions affecting car repair shops with the contiguous building for mill, wheel shop, store house and other accessory departments.

State laws already passed which deal with car repair shops and sheds give ample proof that the development of such buildings is anticipated by interests outside the railway executive offices. Such legislation is largely fostered by labor organizations and the efforts have been to provide the best working conditions and physical protection for the men employed. However, to obtain the best results the planning should be on a broader basis than this and the matter of proper protection for workmen should be viewed simultaneously with consideration of efficiency and economy in the operation of railroads.

In conclusion, attention is drawn to the fact that in comparison with the investment in modern power repair facilities the sums expended to date in car repair shops are but small—probably less than 20 per cent of the former—and yet the annual expenditures for maintenance of rolling stock usually greatly exceed the cost of maintaining locomotives. It has been demonstrated that it has not been possible to realize the ultimate efficiency of the modern locomotive equipped with superheater and mechanical stokers, because repair shops have not kept pace with improvements in the locomotives. It is logical to conclude that the enormous investment in cars may be made more profitable by providing the means for keeping them in shape. By planning car repair shops with some consideration for the observations made above, the results will certainly make for increased efficiency of the mechanics, whose work will, in fact, be changed from an open air occupation, with all the elements of uncertainty peculiar to such work, to modern shop employment of the highest and most satisfactory type. The roads will profit through better workmanship, less frequent delays; improved scheduling of car repairs and lower costs of maintenance.

The Pajaro Valley Consolidated Railroad Company, operating between Salinas and Spreckels, California, a distance of 41 miles, having been authorized by the state railroad commission, will discontinue certain trains and run automobile stages in place of them. The stage line will parallel the railway and will carry passengers, baggage and express at the same rates as are charged on the trains.

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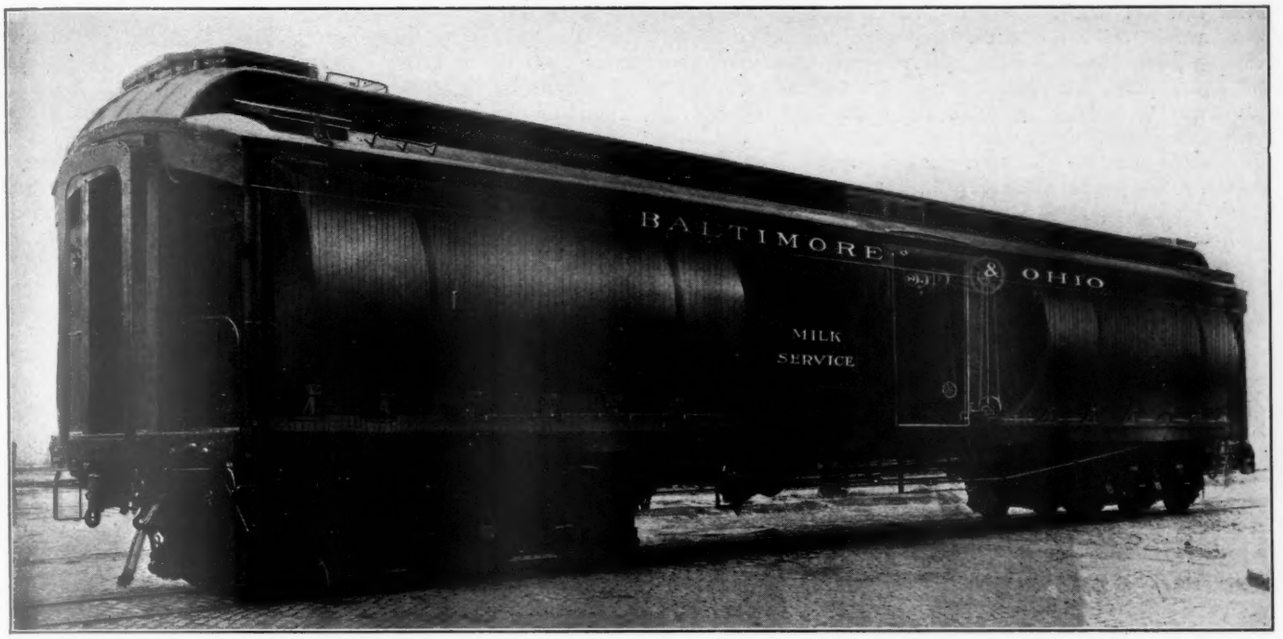
On the Bagdad Railway, Syria



Phantom Illustration of Glass Enameled Tank Car for Transporting Milk

Handling Milk in Specially Constructed Tank Cars

Large Glass Lined Steel Tanks Save Expense in Handling and Haulage—Refrigeration in Transit Eliminated

TANK cars have been used in the past for the bulk transportation of various kinds of liquids, but as far as known no one has attempted the experiment of employing tank cars for the rail transportation of milk previous to their recent adoption by the Baltimore & Ohio on one of its routes out of Pittsburgh.

Milk is one of the most important and one of the most extensively used food products, but it is unfortunately highly perishable and subject to contamination. It cannot be stored for future use but must be collected and transported to the consumer every day. Comparatively few persons fully realize the extreme care that must be taken in the production and handling of milk to insure its sanitation and freshness. It must be chilled promptly and maintained at a uniformly low temperature during transportation for a distance sometimes as much as 300 or 400 miles and all containers must be thoroughly sterilized each time before they are used.

The time honored container for transporting milk has been the 10-gal. can. These are received by the railroad from various milk stations and transported in special refrigerator cars to the distributors in the city who empty the cans and bottle the milk, the emptied cans being returned to the producer. The increasing cost of materials, icing, labor, losses, etc., has been a serious problem for the dairy distributor. There has been difficulty also in maintaining an even temperature by refrigeration on account of the changing atmospheric conditions and the extreme sensitiveness of the product. Any forward step that bids fair to improve the situation is therefore of interest to the railroads as well as to those engaged in the production and distribution of milk.

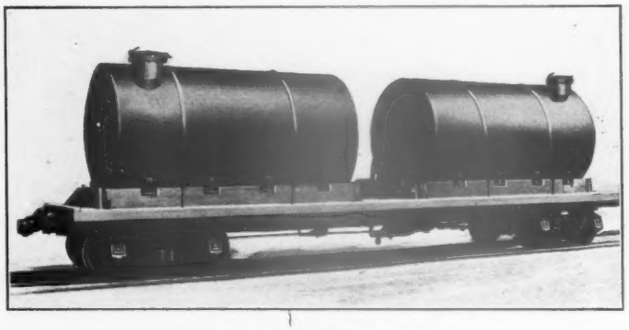
The Pfaudler Company of Rochester, N. Y., manufacturers of glass-enameled steel products, working in conjunction with the Baltimore & Ohio and the Harmony Creamery Company, has perfected a milk car with glass lined tanks. Three of these cars are now in regular service on the Baltimore & Ohio between West Farmington, Ohio, and Pittsburgh, Pa. These refrigerator cars, numbers 897, 898 and 899, are 39 ft. 9 in. long and 8 ft. 3 in. wide, inside measurements. They were originally equipped with brine and ice tanks for refrigerating purposes; these were removed and two steel glass-lined tanks, 11 ft. 2 in. long and 6 ft. 5 in. in diameter were installed. The tanks are made of open-hearth steel plate of a seamless welded construction, and have a capacity of 2,500 gal. each, a total of 5,000 gal. per car, or practically double the capacity of the same car when fitted for transporting milk in the ordinary 10-gal. cans. Each glass-lined tank is provided with sanitary outlets so located as to insure perfect drainage. They are also furnished with manholes at the top provided with quick closing swivel type doors which are air tight, thus increasing the protection of the milk and adding to the insulation efficiency.

The old refrigerator milk cars weighed 51,300 lb. light. Two hundred and fifty 10-gal. cans at 12½ lb. each weigh 3,125 lb. and hold about 21,000 lb. of milk. The actual weight of milk carried was thus only 28 per cent of the total weight of the loaded car, which was 75,425 lb.

The cars after being rebuilt weighed 71,600 lb. with tanks and equipment added. The 5,000 gal. of milk carried weighs about 42,000 lb. or 37 per cent of the total weight of the loaded car, which was 113,600 lb. The total weight to be hauled by the railroad when using tank cars, either loaded or empty, is thus 25 per cent less than by the ordinary method of handling milk in cans.

In practice the milk is brought in from surrounding farms, inspected and, if satisfactory, dumped into receiving tanks and then passed on to the cooler, where it is chilled to a temperature of 38 to 40 deg. From here it is pumped into the car tanks and transported to Pittsburgh.

The cars are equipped with an electric motor which receives current through a cable temporarily connected at the receiving point and is used to operate an agitator inside the tank and a pump for emptying the tanks. Before emptying a tank the agitator is operated for about five minutes to insure a thorough mixing of the milk and cream in the tank. The contents are then pumped out by a rotary pump which raises it to the top of the car where it flows by gravity into a tank on a motor truck which transports it to the dairy which is some distance from the railroad. In cases where

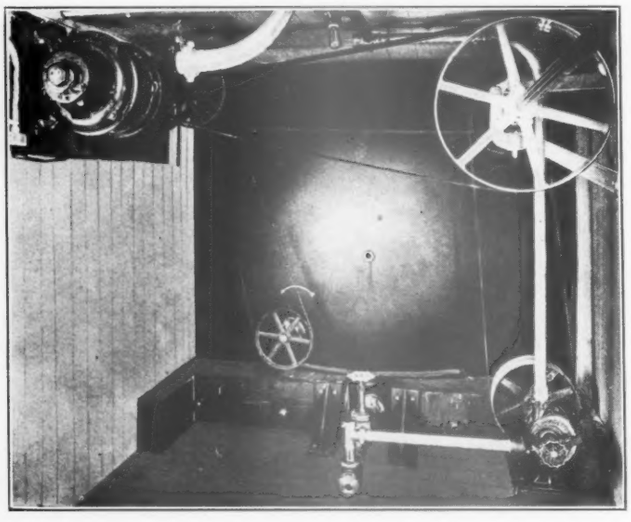


Tanks on Car Without Body

the car can be switched to a siding at the receiving dairy, the milk would, of course, be pumped directly into tanks in the dairy.

The insulating efficiency of the tanks is shown by the fact that during a run of 107 miles from West Farmington to Pittsburgh, and an elapsed time of eight hours, there was a loss of less than two degrees, this result being obtained in August, when the outside temperature reached 88 deg.

There are a number of advantages in the use of these tank cars as compared with the ordinary method of handling milk in 10-gal. cans, among which the following may be



Interior View Showing Tank, Motor, Agitator and Rotary Pump

mentioned: The carrying capacity of the car is doubled. The three tank cars have replaced seven old style refrigerator cars.

The expense of labor and material for icing and brine is eliminated as no refrigeration is required enroute. On the run referred to the charge for icing was seven cents per can.

The tank car method is more sanitary and the milk is kept at a more uniform temperature.

The labor in connection with the loading and unloading of the milk is greatly lessened. No cans have to be handled and shipped back to the owners. Since the adoption of the tank cars the Harmony Creamery Company has been able to dispense with the services of seven men and one three and a half ton truck formerly used to transport cans to and from the cars.

There is less loss of milk which adheres to the containers. The loss from this source is not over eight quarts per day for the two glass-lined car tanks, pumps and piping as compared with one-quarter pint per can or 63 quarts for 500 cans.

The expense of steam and washing compound for the daily cleansing of the car tanks is small in comparison with the expense in connection with the material and washing machinery required for the number of cans necessary for handling the same quantity of milk.

Claims for stolen milk, cream or cans is eliminated as the milk is safe in the large tanks.

It is estimated that the expenses of transportation in tank cars will be 75 per cent less than in cans, or in other words it is anticipated that under the conditions prevailing in Pittsburgh there will be an annual saving amounting to about $10,000 for each tank car used.

British Views on Fuel-Oil Installations*

The mechanical and economic questions involved in the use of fuel oil are receiving the same serious consideration in England as in the United States. During the recent British coal strike C. E. Stromeyer, chief engineer of the Manchester (England) Steam Users' Association, investigated a number of oil-burning installations and submitted his findings to the association in an eleven-page report. The following information abstracted from this report may be of interest.

The types of apparatus in use may be classified as: (a) The pressure-jet system, (b) the steam-jet system and (c) the air-jet system. In the pressure-jet system the oil is atomized by pumping it under pressure through specially formed burners from which it issues with a whirling motion at high velocity. The atomizing is generally better than in the steam or air-jet systems, and combustion may be almost perfect in this type, but the installation, involving a pumping set and special furnace fronts, etc., is considerably more costly.

The air-jet system is little used in power plants because the provision of a compressed-air supply is less convenient and generally more costly than steam, while the system is less efficient than the pressure-jet system.

The sudden cooling of boilers and brickwork should be avoided. Silica firebrick, in particular, is resistant to high temperatures, but is likely to crack if cooled suddenly. Hence, when shutting down a boiler having silica brickwork, it is necessary to keep the air-admission openings closed and allow the brickwork to cool gradually.

Regulation of boiler duty should be effected by adjusting the flow of oil and the air admission. For good results there should be a light-gray smoke at the chimney top. Absence of smoke usually means inefficiency through too much air, while dense black or yellow smoke means too little air or bad atomizing of the oil.

*Reprinted from Power.

IT IS INTERESTING to note that in many of the larger countries abroad the heavy trunk-line electrification projects in the United States have been very carefully studied and are very frequently referred to by foreign consulting engineers in their reports, and that in several instances standard American plans have been adopted practically complete by engineers advising foreign governments on steam railway electrification. It is believed that the experience of American manufacturers in developing reliable heavy railroad equipment in this country will be of considerable help in negotiating a foreign contract.—*Commerce Reports.*

Two Boiler Shop Tools

BY E. A. MILLER

The gage, illustrated in Fig. 1, has proved a valuable tool for indicating the wear of arch tubes in locomotive boilers. Arch tubes often wear thin due to supporting the arch brick or the wearing action of rapidly moving gasses carrying solid particles which have an abrasive action. The arch tubes are three inches in outside diameter and it is evident, therefore, that a gage, constructed as shown in Fig. 1, when applied to a new tube will bear on the tube at three points.

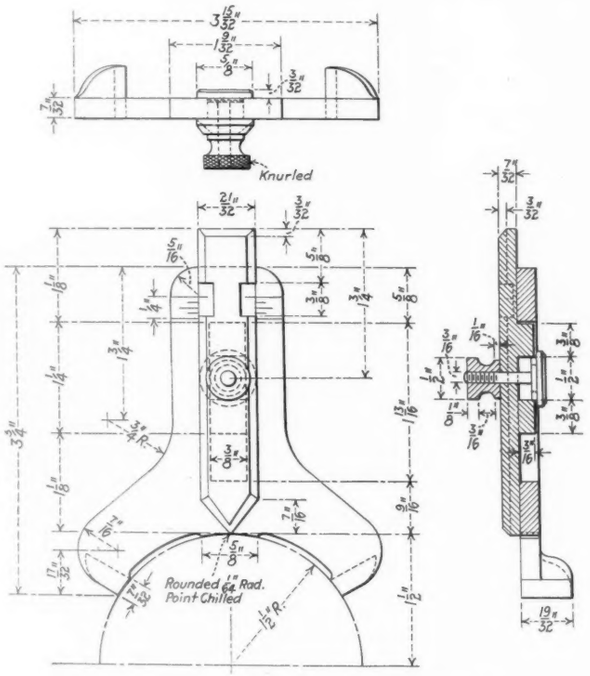


Fig. 1—Gage for Detecting Worn Arch Tubes

The gage is made to the dimensions shown, being provided with a movable pointed slider, graduated at the end to indicate relative positions.

Should an arch tube be worn the gage when applied will not bear on all three points and the point of the slider will extend beyond its normal position. Tightening the set screw will then hold the slider in place and the amount of arch tube wear will be indicated by the reading on the graduations on the upper portion of the gage. Both gage and slider are made of 7/32 in. stock, the slider being guided by a rectangular projection which sets in a corresponding slot in the gage. It is evident that if the arch tube is worn 1/16 in. at a certain point, application of the gage to this point will show a reading of 1/16 in. on the gage.

It is obvious that the gage would give a false impression if used at a bend in the tube where the section is not circular, but experience at the shop where this gage is used indicates that wear does not usually take place at the bends and the gage, therefore, gives accurate indications of defective arch tubes.

Facing Off Electric Welded Tube Ends

For facing off electric welding on the back tube sheets the tool, illustrated in Fig. 2, has proved useful. This cutter is intended for use on small tubes although the same principle could be applied to larger superheater flues. As shown in the illustration, the shank is tapered to suit the air motor

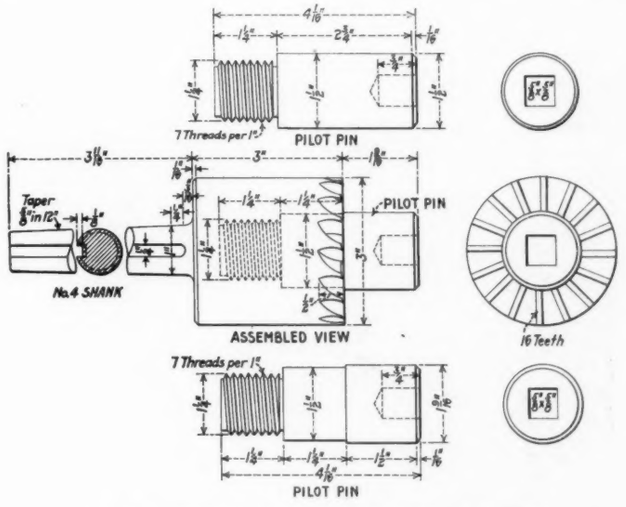


Fig. 2—Cutter for Facing Off Welded Tube Ends

spindle and a large cutting portion, 3 in. long by 3 in. in diameter, is provided with a pilot pin on one end and 16 cutting teeth. The cutting end is bored out 1½ in. in diameter by 1¼ in. deep, then being drilled and tapped for the insertion of the pilot pin.

The illustration shows two pilot pins, 1 9/16 in. and 1½ in. in diameter, one or the other of which will be found suitable for use in nearly all small tubes. The pilot pins are provided with a ⅝-in. square hole in the end as a means of inserting and removing them. The cutter is made of tool steel, hardened and tempered, and the pilot pins of axle steel. Should ordinary carbon steel cutters not be found to stand up under the somewhat severe duty of cutting electric welding, it may be necessary to provide high speed steel cutters either solid or with inserted teeth.

Planer Type Milling Machine Makes Record

Heavy Duty Miller Machines Ten Crossheads or Forty Driving Boxes in Eight Hours at Beech Grove Shops

BY JACOB MARTIN
General Foreman, Beech Grove Shops, Cleveland, Cincinnati, Chicago & St. Louis

THE Beech Grove shops of the Cleveland, Cincinnati, Chicago & St. Louis, under the direction of D. J. Mullen, superintendent of motive power, have been equipped with a 32-in. by 24-in. by 14-ft. Ingersoll milling machine of the four-head, planer type to cope with the demand for production. The results obtained constitute a record which will be of interest to railroad shop men.

This machine was purchased for milling driving boxes and crossheads and Figs. 1 and 2 show the machine set up for these operations. It is the practice of the Big Four to pour brass liners on the shoe and wedge and the hub faces of driving boxes, and it was formerly the practice to plane the shoe and wedge faces. Ten was the average number of driving boxes planed in eight hours at Beech Grove. Since machining driving boxes on the milling machine, we have obtained an average of 40 boxes per eight-hour day, the actual cutting time complete per box being five minutes; setting up time, seven minutes; making a total of 12 minutes from floor to floor for each box. The established feed is 40 ft. per min, for cutting speed, and 4.2 in. per min. for table feed. These speeds and feeds have proven desirable on this class of work as we machine from 80 to 90 boxes with one grinding of the cutters. It will be noted that the setting up time exceeds the cutting time, and the small amount gained by using a higher speed does not offset the loss in grinding or changing the cutters.

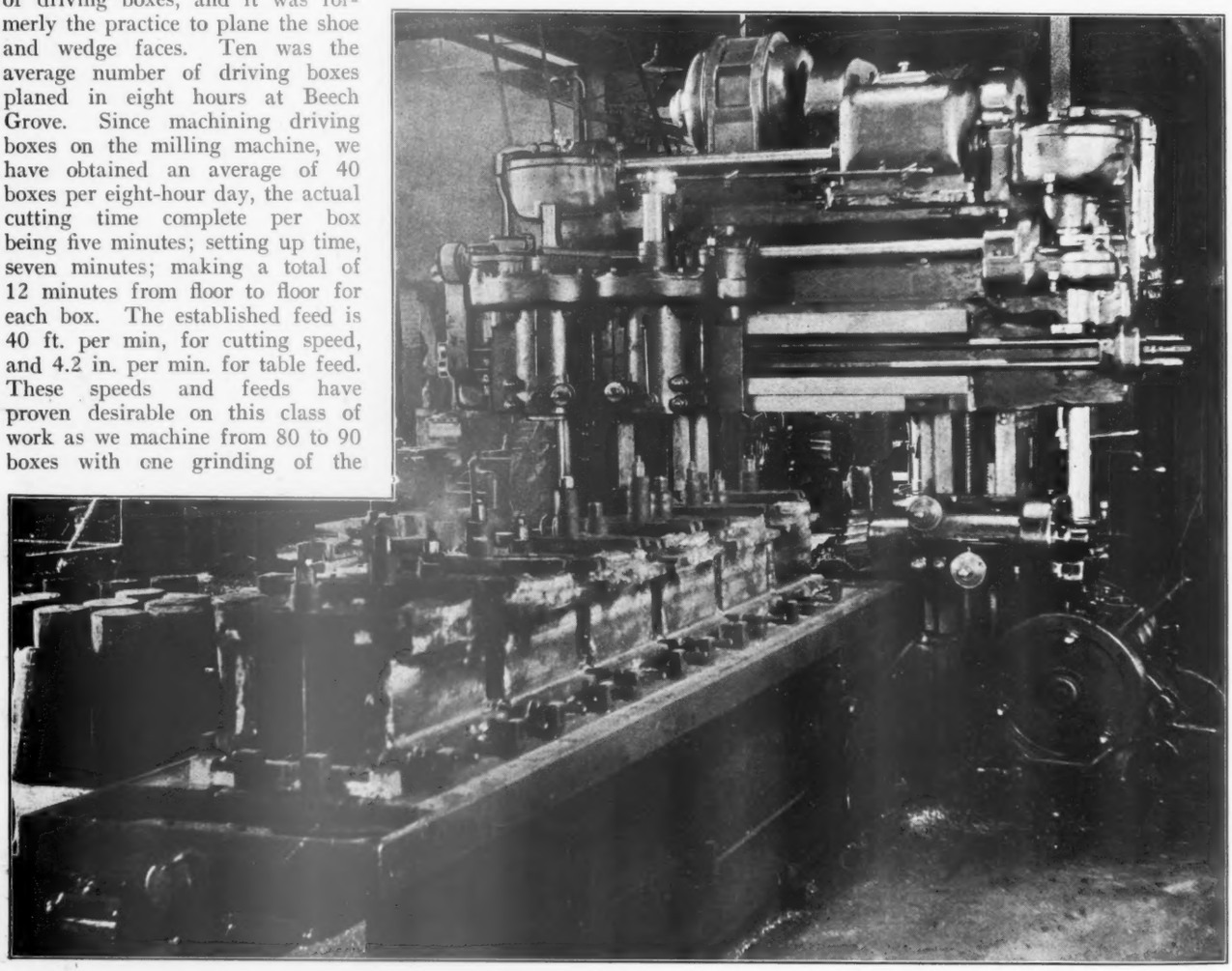


Fig. 1—Ingersoll 32-in. by 24-in. by 14-Ft. Milling Machine Equipped for the Rapid Machining of Driving Box Shoe and Wedge Ways

When old liners are tight on driving boxes and do not need renewing, but must be trued up on account of their worn condition or the shoe and wedge faces being out of parallel, it is not necessary to remove much material. In truing up old boxes we use a cutting speed of 60 ft. per min. with a table feed of 10.2 in. per min. This reduces the cutting time to two minutes per box and setting up time to seven minutes, making a total of nine minutes from floor to floor, for this class of work.

Machining Crosshead Shoes

It is also the general practice in railroad shops to plane crosshead shoes where soft metal is not used. The Big Four standard crosshead shoe is made of cast iron of the herring-bone type, the cavities in the shoe being filled with soft metal. On account of the small projection at the top of each dovetailed groove, the metal is always more or less hard. The hardness of this metal makes unfavorable machining conditions, but gives good wearing service. The Big Four

formerly planed these crossheads, approximately three being planed in eight hours. This job could not be crowded on a planer to any great extent on account of the tool breaking out portions of the cast iron at the top of the dovetail and forcing them into the soft metal. One familiar with the planing of a surface of this kind will appreciate the care that must be taken to get a true surface on account of the tool passing over a small portion of hard cast iron and then over a portion of soft metal. If great care is not taken the cast iron part will be high and the soft metal part will be low. The hardness of the cast iron still remains a factor in the milling of these shoes which is an explanation for the reduced table feed used by the Big Four. Ten is the average number of crossheads machined per eight hours. The table feed is 2 in. per min.; cutting speed for largest diameter cutter 40 ft. per min.; actual cutting time 28 min.; setting up time for first cut 12 min. and for second cut 8 min., making a total of 48 min. from floor to floor. With this machine we average 18 crossheads machined with one grinding of cutters.

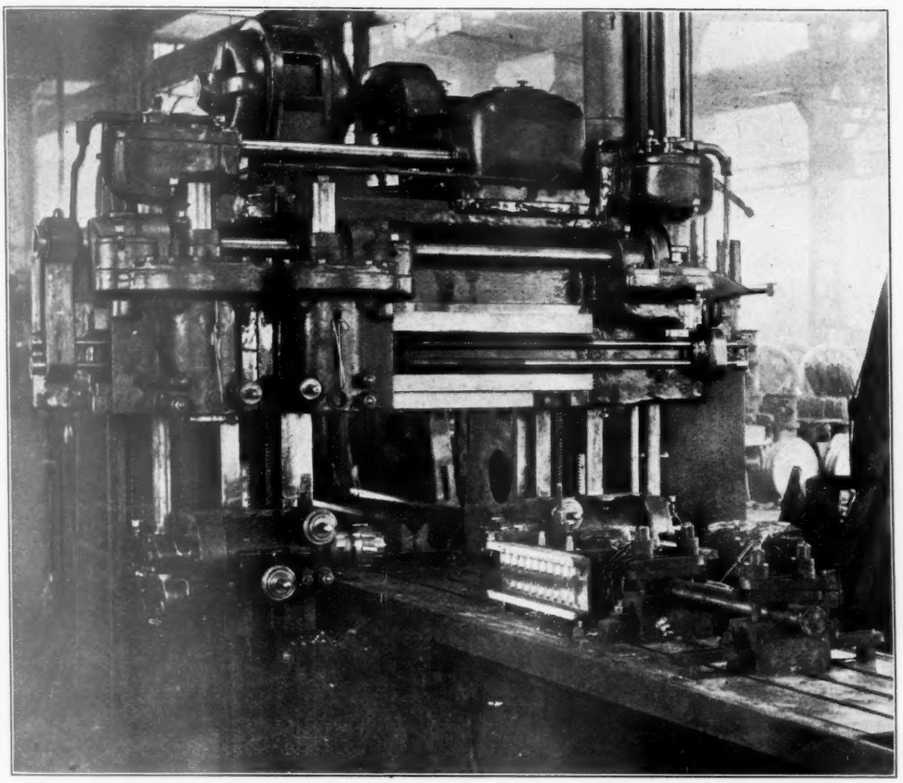


Fig. 2—View Showing Set Up for Machining Crosshead Shoes

Advantage is taken of more favorable iron whenever possible to increase the table feed to 3 in. per min. and using 60 ft. per min. cutting speed for the largest diameter cutter. From the illustrations it will be noted that we use two cutters, in pairs, on the crossheads. The smaller diameter which works inside the crosshead shoe is removing the most metal; the outer cutter is only machining the outer surface to the proper height. Due to the small amount of metal being removed, this cutter stands up at a higher cutting speed.

The tools used in connection with this work are shown in the line drawings. Fig. 3 shows a height gage for setting cutters to the desired height. Fig. 4 shows a centering block and gage used for setting the part to be machined. Fig. 5 shows standard gages used in connection with the centering block for setting cutters to the desired width.

Advantages of Planer Type Milling Machines

The advantages of planer type milling machines using end and face cutters, over planers for production work cannot be denied. Some of the desirable features of the milling machine are :(a) The large percentage of total power consumed by actual cutting of the metal instead of moving the part machined and the machine table back and forth; (b) the continuous cut; (c) the reduction in time required for tool setting and grinding of tools. This adds to the efficiency of the operator and the quantity, quality and accuracy of the work is increased. The fact cannot be overlooked that on the planer there is only one tool cutting, while the milling machine will have from 12 to possibly 36 cutting points. The milling machine cutter, with the greater number of cutting blades, can be removed and replaced in practically

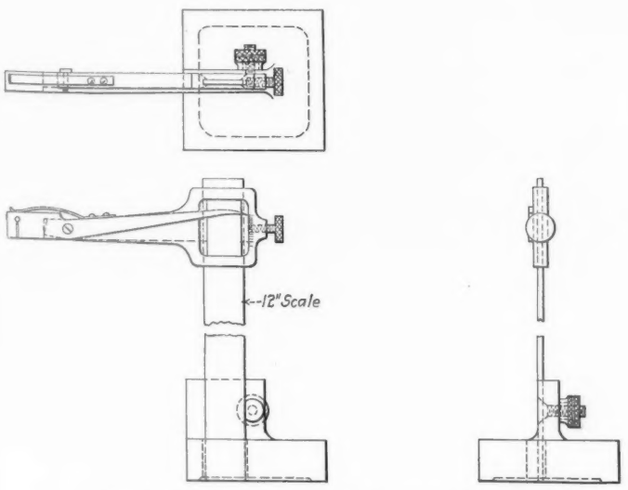


Fig. 3—Height Gage for Setting Milling Cutters

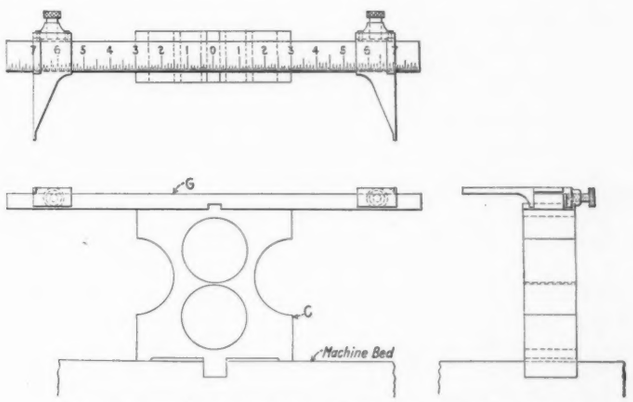


Fig. 4—Centering Block and Gage for Centering Work

the same time that it takes for the one tool on the planer. The grinding is also accomplished under favorable conditions on mechanical grinding machines so that machine will not be idle for tool changes or tool grinding more than a minimum length of time.

The mechanical departments of the railroads have as a rule been alert to the above facts but have been reluctant to install milling machines in place of planers due to the initial cost of purchase and installation and the fact that railroad repair work cannot always be handled on a production basis. The number of parts to be machined often does not warrant the investment in special cutters and is insufficient to justify a milling machine set-up. Another fact to be confronted is that castings received in railroad repair shops are not made for rapid machining, but to meet the requirements of the service, which as a rule results in more or less

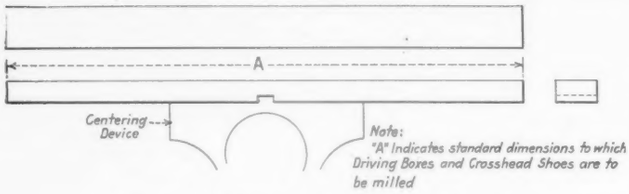


Fig. 5—Gage for Setting Work and Cutters

hard castings. Still another factor that probably has some bearing on the delayed adoption of planer type milling machines by railroads is the few machines of this type being used in railroad shops which would naturally cause some skepticism as to their value for this particular work.

Large railroad shops are becoming more numerous and in analyzing shop conditions, it is common to find one or more machines confined to the manufacturing of a single part. This means that production methods and machinery should be installed and it was with this thought in mind that the Big Four developed the foregoing method of machining driving boxes and crossheads. The adoption of the milling machine enabled driving boxes to be machined four times as fast as formerly and crossheads a little over three times as fast.

Six-Roll Superheater Flue Expander*

There exists a difference of opinion among engineers as to the advantages and disadvantages of the six-roll flue expander as compared with the three-roll type for the superheater flue work. On small tube work, the three-roll expander is universally used, and when the superheater was fitted to British locomotives the expander for the large flues was designed on similar lines to the small tube expander. The roll box of the expander was made with an adjustable cap to enable the rolls to be adjusted to suit various tube sheet thicknesses. It is necessary that a flue should be expanded about ⅛ in. through the sheet, and the cap on the three-roll expander enables the operator to do this.

This cap is fixed, and therefore the length of roll is not controlled by the operator, an important point, since when new flues are inserted in a flue sheet they are first expanded, then beaded over and afterwards re-expanded. When this work is done by the six-roll expander the first expanding lays down only a portion of the flue, as the allowance for beading, 9/16 in. prevents the rolls from passing further into the flue. After the flue is beaded the re-expanding covers an additional portion of flue, which is not good in practice. This trouble does not exist when the three-roll expander is used, as the cap fits over the beading and rests against the flue sheet. The length of the flue expanded thus remains constant.

*From the November, 1921, Railway Engineer.

The three-roll expanders are fitted with a nut on the end of the mandrel, which is used for removing the expander after the flue has been sufficiently expanded. This nut is screwed against the box portion and the mandrel is thereby forced out. The pressure necessary to make a good joint is obtained by driving the tapered mandrel in with a copper hammer and turning with a ratchet. In the six-roll expanders the rolls are inclined, so that they will tighten up during the action of expanding. The flues are expanded by turning the mandrel to the right, and the expanders are released by turning the mandrel to the left. This is an advantage, as hammering the mandrel drives the rollers on to the flue at points of contact, and tends to make grooves in the tube surface. It is necessary that the inclination on the rolls be made so that they will not tighten the expander too suddenly, and at the same time be sufficient to release the expander without the operator having to resort to the use of a hammer.

An advantage which the six-roll expander has over the three-roll expander is that, having several points of contact, the tendency to straighten out the flue between the rolls is negligible. Consider a three-roll tube expander inserted in a tube 4 15/16 in. in diam. which is in position in a flue hole 5 in. in diam. The spindle, on being driven in, lays the flue down in three places, the metal of the flue between these points, about 5¼ in. apart, being lifted further through the flue sheet and somewhat straightened. A similar flue expanded with the six-roll expander would be opened evenly and gradually, as no driving of the mandrel is required with this expander.

After a boiler has been working for a time the flue sheet holes become misshapen, due to upward expansion of the firebox, downward thrust of the steam pressure on the firebox crown, and stress put into the flue sheet by expanding the flues. The flues in the misshapen holes give considerable trouble from leaking, and have to be re-expanded from time to time in the locomotive terminals. It is not economical to remove these flues and round up the holes by means of rosebitting, as frequently the flues are of good thickness. It is possible to make such flues steam tight with a three-roll expander, but this cannot be done with the six-roll expander. When operating in an oval-shaped hole the mandrel of the three-roll expander takes an eccentric path, which allows it to press on the rolls as they pass over the portion of flue which is out of shape, thus allowing the flue to be made tight.

The six-roll expander will not do this, as having more points of contact the rolls are permitted to ride loosely over the misshapen portions of the flue. An experiment was made in this direction on a leaking flue, which was ⅛ in. out of round. The flue was covered with chalk internally and well expanded with the six-roll expanders. This failed to stop the leakage, and on removing the expander it was found that the chalk was cleaned from the sides of the flue, but remained on the top and bottom. On expanding the same flue with a three-roll expander the leakage was stopped and it was found that the chalk was well cleaned off all round the flue.

If expanding could be continued with the six-roll expander the flue hole would be rolled round, but this is not to be desired, as adjacent flues would be affected. Also the inclination on the rolls would prevent this being done, as the expanders would get so tight as to become immovable before the shape of the hole had been appreciably altered.

To sum up, the six-roll expander in its present form requires modifying and fitting with an adjustable cap which would make it most suitable for new work and for expanding flues in sheets which have had their flue holes rosebitted round. The three-roll tube expander is most suitable however for the tube repairs which have to be made in locomotive terminals.

Fig. 1—Bulldozer, Fitted Up to Form Draft Sill Reinforcement Channels at One Stroke

Machine Forging Work at Elizabethport

Many Locomotive and Car Parts Are Made at a Minimum Cost by Use of Production Forging Machines

IT is generally admitted that the rapid increase of autogenous cutting and welding in railroad shops has made heavy inroads into the work formerly done by blacksmiths. In spite of this fact, however, 110 men, or approximately the normal pre-war force, are employed in the blacksmith department of the Jersey Central shops at Elizabethport, N. J., and the visitor at that shop can hardly fail to be impressed with the businesslike, production methods used in securing output. Probably this impression is largely due to the great amount and variety of machine forging work, varying from the manufacture of bolts to all kinds of forged shapes used at different points on the system. Credit for the development of this work and the design of the forging dies is due to G. W. Kelley, blacksmith foreman at Elizabethport and formerly president of the International Railroad Master Blacksmiths' Association.

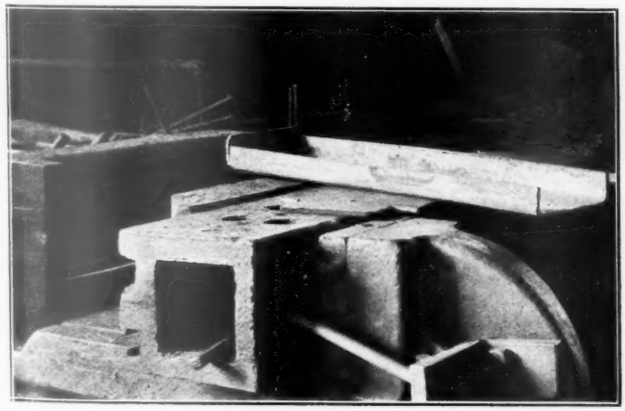


Fig. 2—View of Finished Reinforcement Channel

Four forging machines are used at the shop, including a No. 3 Ajax bulldozer, No. 5 Universal Ajax forging machine, 1½-in. Acme forging machine and 1¼-in. National hammer bolt machine. A wide range of work is performed on these machines and the four typical examples described below are given because of their general interest.

Draft Sill Reinforcement Channels

Channels, used to reinforce draft sills, are made at one stroke of the bulldozer illustrated in Fig. 1. These channels are made of ½-in. steel plate with 3-in. by 4-in. rectangles cut out at two corners, one being shown at *A*, Fig. 1. The plates before banding are 50 in. long by 17 in. wide and are drilled with three holes so that after heating they can be accurately located by pins on the solid former. (Plate shown in position before bending in Fig. 1.) One stroke of the movable die bends both sides and one end, leaving the chan-

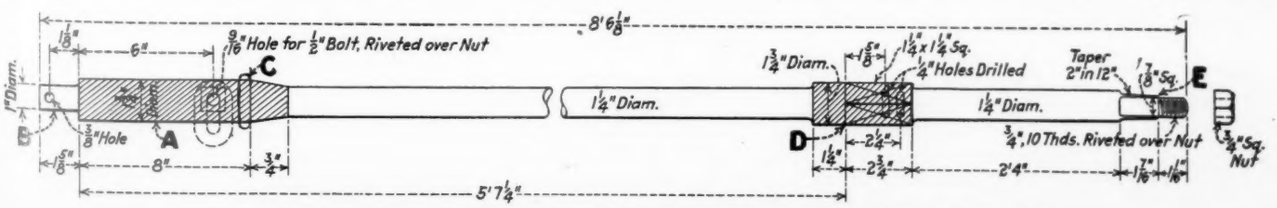


Fig. 3—Details of Brake Shaft Made of a Single Piece of 1¼ in. Round Stock Without Weld

nel in the form shown in Fig. 2, the channel then being 46 in. long by 11 in. wide, with two sides 3 in. high and one end 4 in. high. Three men are required for the manufacture of these channels which are made at the rate of 10 to 12 per hr.

Double Upsetting a Brake Shaft

Owing to the I. C. C. requirements that brake shafts for freight cars be made without weld, it is necessary to upset each brake shaft at two points a considerable distance apart. Fig. 4 shows a number of completed brake shafts fo 80,000-lb. capacity coal cars. Details of this type of brake shaft are shown in Fig. 3, from which it is evident that the shaft is made of 1¼ in. round stock upset at two points a distance of 5 ft. 7¼ in. apart. It is plain that if these two operations are to be performed on a forging machine some method must be devised to extend the dies for one operation allowing the rod to pass over the top of the machine. A set of shafts with one end formed are shown in the insert in the lower left corner of Fig. 4. The completed shafts are shown full length in Fig. 4, being upset and formed at points *B* and *C*. The preliminary operations are performed on the forging machine illustrated in Figs. 5 and 6. Referring to Fig. 3, the first operation is to upset the right-hand end of section *A* to 1¾ in. and 1⅞ in. in diameter. The second operation is to pinch section *B* to 1 in. round as shown. Section *A* is too long to be upset at one blow and the third operation therefore consists of upsetting the left-hand end of section A to 1¾ in. in diameter. The entire section *A* therefore is upset to 1¾ in. diameter, but with a slight taper, and the same blow which performs the final upsetting, pushes off the excess stock in the form of collar *C*, leaving section *A* 1¾ in. in diameter at one end by about 1⅞ in. diameter at the other end. This taper is removed by the hammer swager *A* (Fig. 6), operated under the vertical press which forms a part of the forging machine.

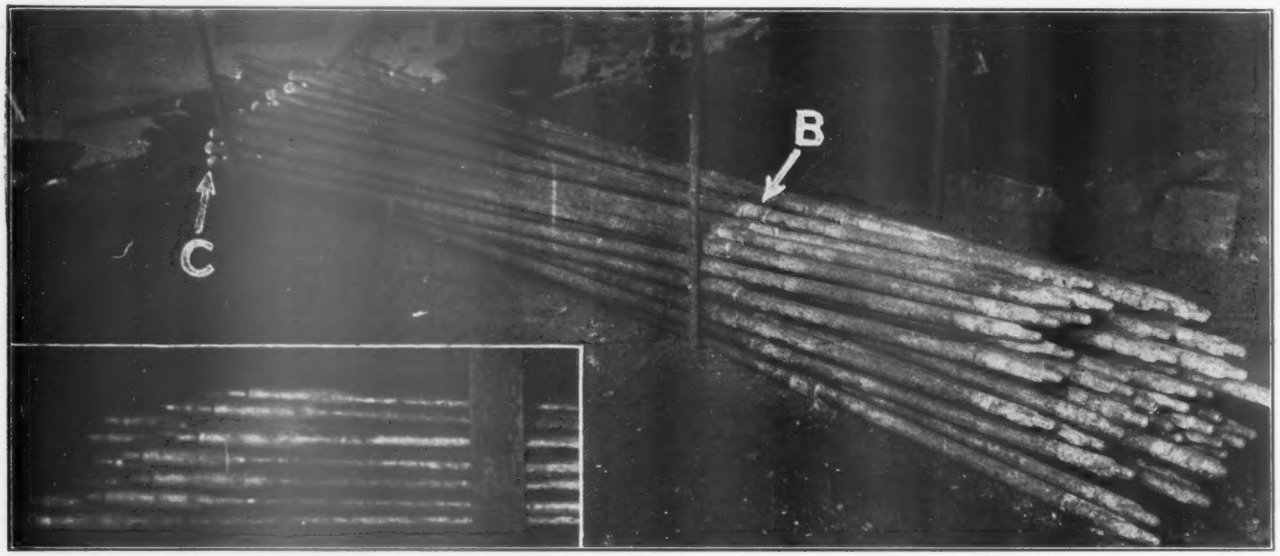


Fig. 4—Finished Brake Shafts Upset at Two Points, 5 Ft. 7¼ In. Apart

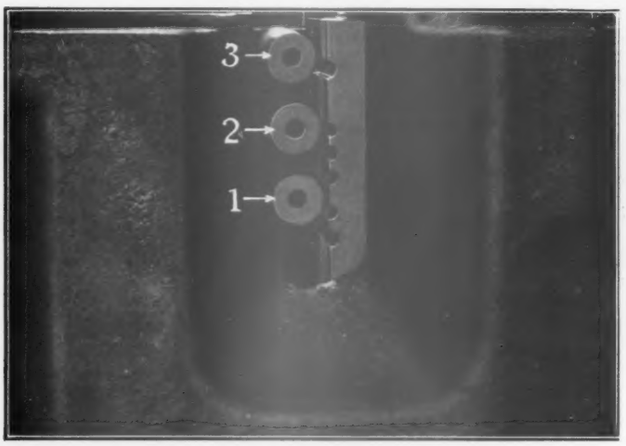


Fig. 5—Universal Forging Machine Equipped to Form Brake Shaft Ends

Referring again to Fig. 3 the second forging operation on the brake shaft is to upset section *D* 1¾ in. in diameter by 3¼ in. long using extension dies, half of which are shown in Fig. 7. These dies are secured in the forging machine in such a way that the upper part extends above the machine, allowing brake shaft end *A* to extend over the top of the machine so that a second upsetting operation can be performed at *D*. In Fig. 7 *A* is the moving die and *B* the fixed die. *A* and *B* are held in alignment by two pins and sep-

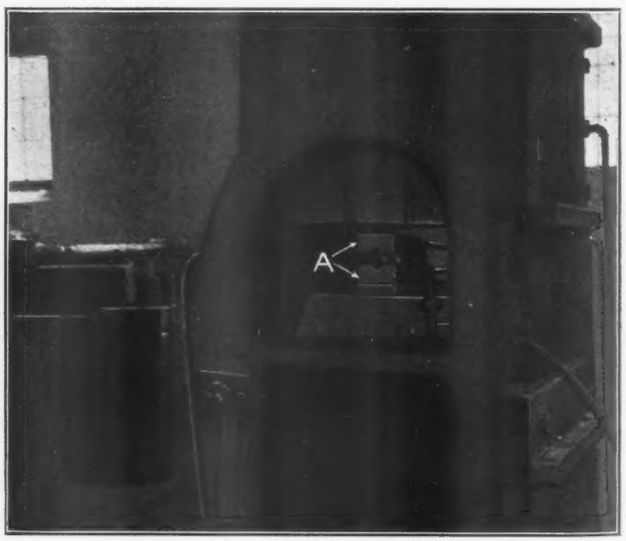


Fig. 6—View Showing Vertical Press and Hammer Swager

arated after each stroke by the two springs shown between them.

In operation the brake shaft is heated at the correct location and a similar pair of dies come against dies *A* and *B*,

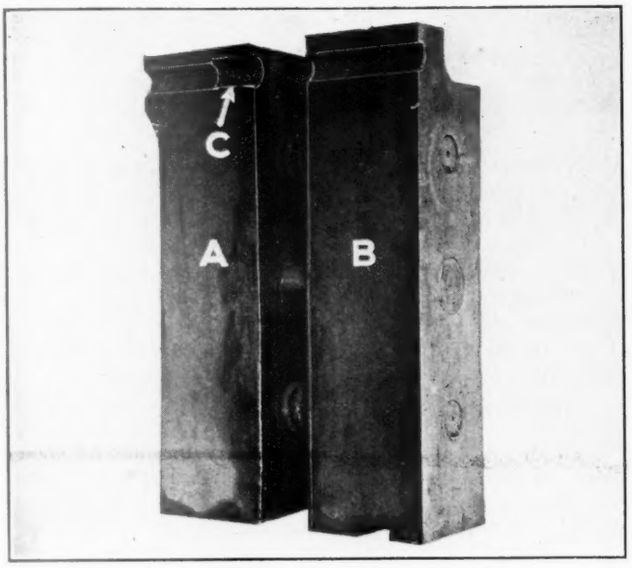


Fig. 7—Extension Dies for Forming Second Upsetting Operation on Brake Shafts

gripping the stock firmly. Die *A* then, in conjunction with its mating half, moves up to die *B*, compressing the heated portion of the brake shaft into cylindrical cavity *C*. It will

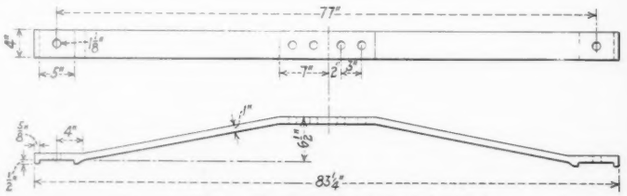


Fig. 8—Details of Tender Truck Cross-Tie

be noted that one portion of brake shaft section *D*, 2¼ in. long, is square, the operation of squaring being performed on the vertical press equipped with a suitable hammer swager.

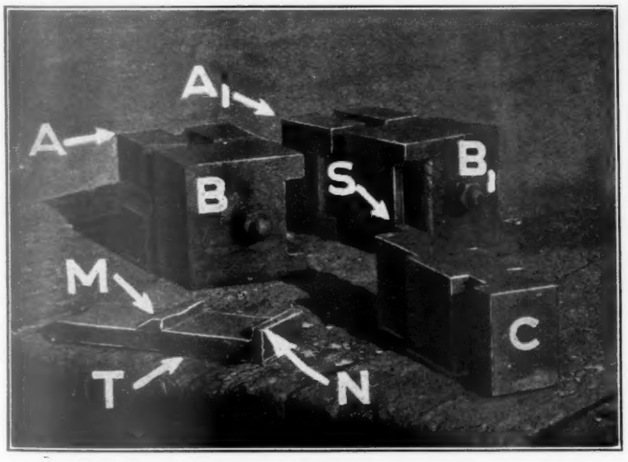


Fig. 9—Dies for Forming Cross-Tie Ends

The brake shaft end *E* (Fig. 3) is made under a power hammer because this is a simple operation which would be costly if performed on a powerful, high-priced machine. Two men are required to handle material and operate the machine while making brake shafts and sections *A* and *D* can be formed at the rate of about 15 per hour, the time required for making section *D* being slightly less than that for section A.

Tender Truck Cross-Ties

The details of a cross-tie for tender trucks are shown in Fig. 8 and this cross-tie is made from a single straight piece of 1-in. by 4-in. stock with the ends formed as shown and of the proper length to make the cross-tie, illustrated in Fig. 8, when necessary bends have been made. The dies for forming the ends are shown in Fig. 9, a view of sample end T being given to show the toes *M* and *N* formed by the dies.

The dies are set up in the forging machine, die *A* being solid. In operation the heated stock is fed in the proper distance and dies A_1 B_1 move over to dies *A B*, gripping the stock. Dies *B* B_1 then advance on *A* A_1, forming toe *M* and being forced to move by the advance of die *C* on the ram of the forging machine. Die *C* forms toe *N* on the cross-tie shearing off any excess stock by means of projection *S* passing into the slot in B_1. These cross-tie ends are formed at one stroke of the machine at the rate of approximately 20 per hr. depending upon the facilities for heating.

Method of Making Boiler Crow Feet

The dies for rapidly making boiler crow feet, also a finished crow foot, are shown in Fig. 10. *A* and *B* are double

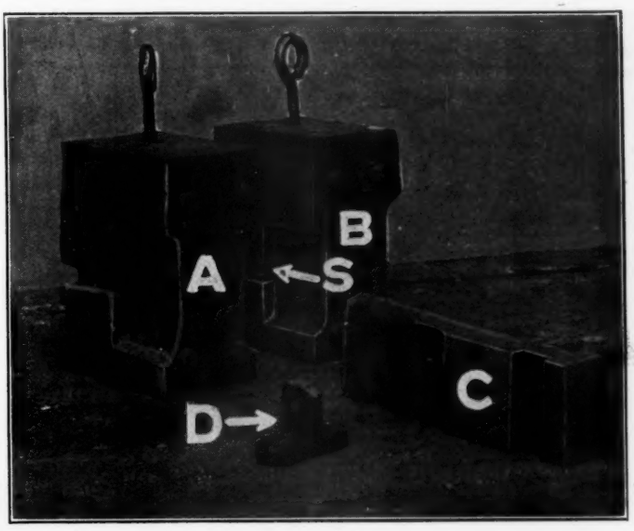


Fig. 10—Dies for Forming Boiler Crow Feet

dies which can be used to make two sizes by simply reversing them in the forging machine.

In operation the 2¼-in. by 1-in. stock is heated and fed the proper distance into slot *S* between dies *A* and *B*. Die *B* moves against *A* gripping the stock and the advance of die *C* then compresses the excess material to form the crow foot, shown at *D*. Crow feet are cut off and shaped in one stroke of the machine at the rate of 25 or 30 an hour. The crow foot, illustrated, is 6 in. long by 4 in. high, being made of 2¼-in. by 1-in. stock.

ROCH LANCTOT, a prominent French-Canadian member of the Canadian Parliament, in a recent speech at St. Edouard de Napierville, Quebec, declared that the Government of Canada would be wise to rid itself as soon as possible of the publicly owned railways. "What is the use of adding to an investment that produces nothing but deficits?" asked Mr. Lanctot. "I would prefer to sell the whole thing to the Canadian Pacific for a dollar. The government is not capable of running railways on a business basis; there is too much temptation."

Standards of Railroad Shop Welding Practice

Workable General Rules Are Given; Also Typical Examples of Proved Boiler Welding Practice

BY G. M. CALMBACH
Welding Engineer

IN order that greater uniformity and better results may be obtained in preparing work and making welds, the following methods and practices have been selected after considerable study, experiments, and personal observation of the welding work in many shops throughout the country. They are considered the best and most practical methods in use today and are recommended as standard practices, to be followed as closely as local conditions will permit. Each foreman and welder who follows these instructions will find his work more reliable and satisfactory.

1.

In welding cast iron, brass, cast steel, and forgings, all such work should be fire-heated whenever possible to insure a better weld, as well as to save gasses. That is to say, all parts that take considerable time to heat with the torch sufficient to commence welding should be preheated so that when the welding flame is applied the part to be welded will respond almost immediately. As the oxy-acetylene torch cost per hour is extremely high it is easy to see that the heating of ordinary heavy parts with the oxy-acetylene flame is a very expensive operation and should be eliminated as much as practicable.

All foremen in charge of such work should use good judgment and take personal interest in this matter and see that the proper provisions are made and work carried out accordingly. The preheating of cast iron, brass and other heavy castings is not only necessary for the saving of gasses and time, but is also necessary in many cases to take proper care of expansion and contraction.

2.

In making a successful weld there are five very essential and important things to consider: namely, (1) Condition of surfaces; (2) bevel of sheets; (3) position of sheets; (4) provision for expansion and contraction, and (5) proper filler metal.

The importance of these points cannot be over-estimated and the failure to comply with the instructions covering any one of them will result in a questionable or bad weld. The success of a weld depends on the rigid observation of these items.

3.

When sheets and patches are to be applied extreme care should be taken that all defective parts are cut out and also that they are cut so there will be a good foundation for the weld.

4.

All sheets and patches should be cut out on a straight or uniform line, avoiding staybolts wherever possible so that staybolt threads may be cut in unwelded plate.

5.

Never cut out sheets or patches through the old weld where sheets have been welded previously. For side sheets or three-quarter door sheets, extend the new sheets at least one staybolt row higher; for crown sheet, one staybolt row lower; for patches, at least one row of staybolts larger; for flue sheet, extend weld to one row of staybolts lower.

6.

Do not cut out sheets or patches and bevel the sheets at the same time. If the sheets are to be beveled with the torch before chipping it can be done after the parts are cut out; this is necessary to insure a uniform line, as well as a more perfect fit of the new parts.

7.

Clean surfaces are absolutely necessary for making good welds. If scale, rust, or grease is permitted to remain on the surface to be welded a slag is formed that will make a streaked and seamy weld. All surfaces must be kept free from foreign substances; all welding surfaces must be kept clean and bright.

8.

Experience has proven that the most satisfactory angle of the beveled faces preparatory to making the weld is an angle of 45 deg. with the surface of the sheets. The total angle between bevel faces must be 90 deg. in all cases, even if one sheet has to be beveled more than the other. Improperly beveled sheets prevent the welding flame from properly penetrating the bottom of the weld and prevent the weld from uniformly uniting with the edge of the sheet.

9.

Where horizontal welds are to be made with the electric welder it has been found a very good policy to bevel the

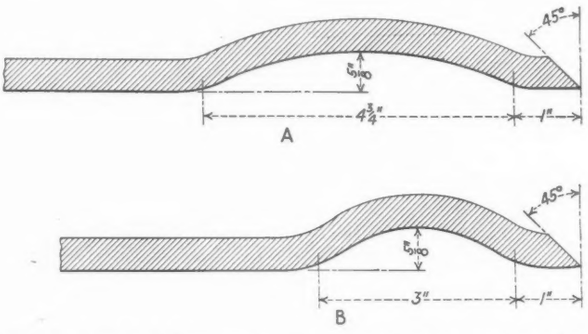


Fig. 1—Standard Corrugations for Boiler Sheets and Patches

bottom edge to about a 60-deg. angle and the top edge to about 30 deg.

10.

All sheets and patches are to be fitted carefully with an opening of 1/8 in., no more and no less, between bevel edges. Less than 1/8 in. opening between the sheets will not permit the welding flame to penetrate the weld properly and a greater opening requires too much filler metal to be used, not only increasing the cost of the weld, but making it impossible to keep the surface of the weld opposite the torch smooth. This rough surface permits lamination and seams

on the water side of the sheet, weakening the weld and permitting early corrosion of the metal which tends to part the sheets.

11.

All other precautions may be carefully made and yet a faulty weld will be made if due care is not taken to allow for expansion and contraction of the sheets. Where it is not possible to obtain the necessary expansion and contraction through curves of the adjacent sheets, it is then necessary to provide some method to take care of expansion and contraction. In this case all sheets and patches will be

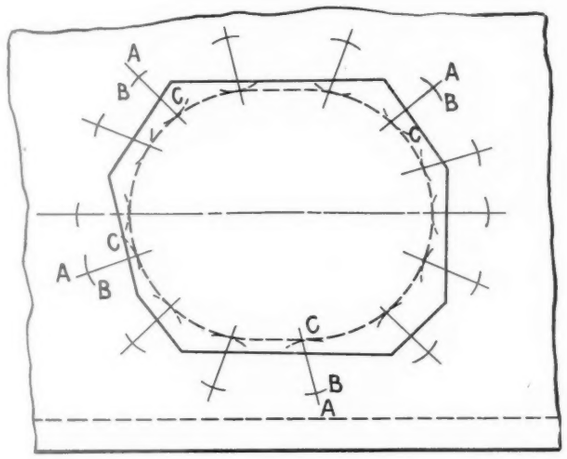


Fig. 2—Method of Laying Out Patches for Welding

corrugated, as shown in Fig. 1. A strain on a weld, especially where the new sheet is welded to an old sheet, which is generally the case, is particularly harmful as the old sheet will not stretch as much or as uniformly as the new one.

12.

When fitting corrugated sheets or patches, they should be bolted securely in place and when they extend to the mud ring good drift pins should be inserted in the mud ring holes so that the sheet cannot move upward due to the contraction

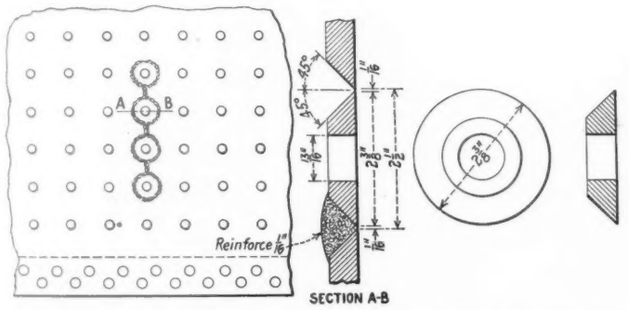


Fig. 3—Method of Welding Cracks Through Staybolt Rows; Gas

as the contraction should be taken from the corrugation. Bolt the sheets at the welding end as usual. That is to say, insert a 5/8-in. bolt through every fifth staybolt hole and screw in a staybolt from the outside between each of the 5/8-in. bolts, thus holding the sheets in line. Then insert small wedges between the welding edge spaced about 14 in. apart to keep the sheet from pinching together during the welding.

13.

Where side sheets are to be welded at the ends it is necessary to remove the adjacent row of staybolts to the edge of flange of door or flue sheet before welding is commenced. It is also advisable to remove all staybolts adjacent to welds after the welding is completed.

14.

When welding corrugated sheets or patches with the oxy-acetylene method the following instructions are to be carried out; with every 12 in. of welding completed, the operator will stop and heat a line 1 in. wide through center of corrugation to a red heat and continue this until the weld is finished.

15.

No fire box welds should be reinforced more than 1/16 in. as too great a reinforcement is injurious to a weld due to over-heating when in service.

16.

For firedoor patches when collars are to be welded they should be cut out at a point where at least one row of staybolts is in the patch and as nearly round as possible. When the patch is cut out at a point 6 in. or more from the firedoor edge it should be corrugated all around as shown in Fig. 5. It will not be necessary to corrugate if the patch is cut out less than 6 in. from the door hole. When firedoor patches are extended to the mud ring and 6 in. or more from the firedoor edge the patch will be corrugated all

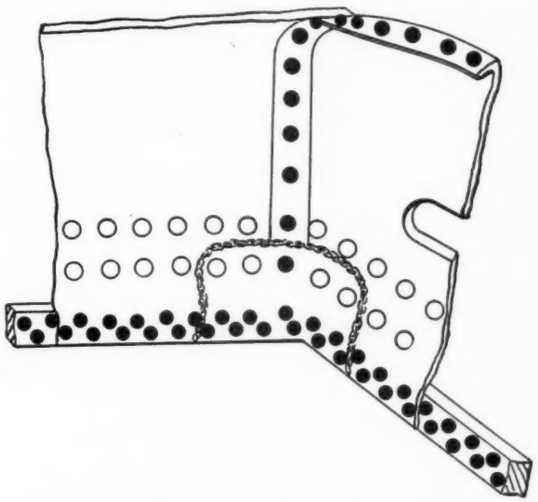


Fig. 4—Application of Mud Ring Corner Patches; Gas or Electric

around but where patches do not extend to 6 in. from the firedoor edge, it will only be necessary to corrugate both sides of the patch from a point about half way from the firedoor down to the mud ring.

17.

The welding of cracks in side sheets, door sheets, firedoors, crown sheets, bottom and top of flue sheets should never be attempted as such attempts have been a source of much trouble and many engine failures. However, it may be considered necessary at times to weld certain cracks. This practice should be resorted to only in occasional emergency cases and then such work should be classed as strictly temporary and be corrected at the first opportunity. It is, of course, known that such work as welding cracks in the barrel of a boiler, welding over staybolts and welding staybolts is strictly against the law and will not be allowed at any time.

18.

When it becomes necessary to weld seams that have given away, such as those between door or flue sheets and side

sheets, the rivets should be removed and the outside of the fire side lap should be cut off through the center line of rivet holes. Do not cut the side sheet and see that it is cleaned thoroughly before welding is commenced. Weld the holes solid and lap weld sheets.

19.

Fitting, Preparing and Welding Fireboxes

For fitting, preparing and welding a firebox without removing the back end the firebox should be set up on the floor with all staybolts and mud ring rivet holes drilled, except mud ring corner holes, which should be drilled after the sheet is up and welded.

The welding edge should be chipped to a 45-deg. angle

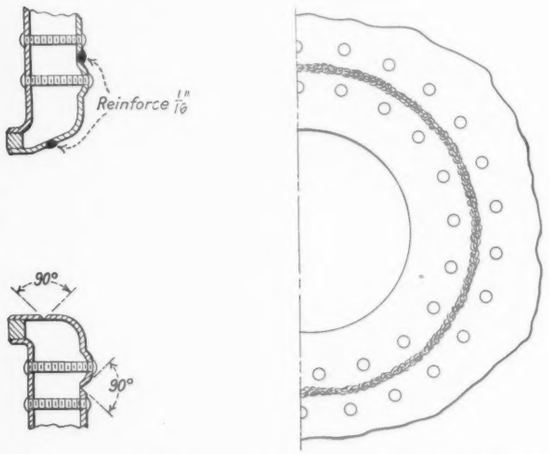


Fig. 5—Butt Welded Fire Door Patch; Gas or Electric

and chipped on a straight line so as to insure a uniform opening of ⅛ in. between the welding edges.

The lower portion of the sheet from a point about 14 in. from the bottom of the flue and door sheets should not be chipped until the box is in place and the mud ring corners in place.

Bolt the sheet securely in place, being sure that there is

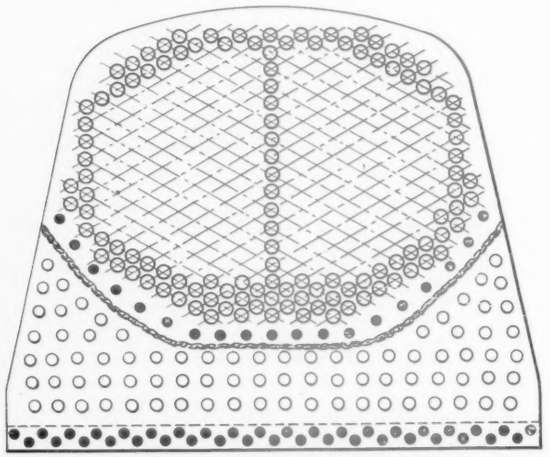


Fig. 6—Method of Applying New Tube Sheet Section; Gas or Electric

a uniform opening of ⅛ in. all around the welding edge.

Use a ½-in. drill and drill holes spaced about 14 in. apart, using ½-in. machine bolts with clamps made of boiler plate ½ in. by 2 in. by 4 in. Use one of these pieces on each sides of the sheet, being sure that all bolts are drawn tight.

Rivet the top of the flue sheet to a point not less than 12 in. below the center of the crown; start welding at a point about 10 in. below the rivet and weld up to the rivets. Then drop down 10 in. and weld up to the end of the previous weld. Continue this operation until completed,

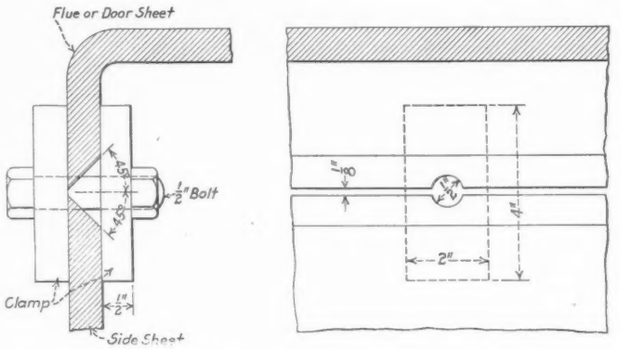


Fig. 7—Clamp for Holding Fire Box Sheets in Line when Welding

removing clamps when necessary. Weld the entire door sheet.

Examples of Boiler Shop Welding

The method of making corrugations for side and door sheets to allow for expansion is shown at *A*, Fig 1. The corrugation for patches is more pronounced and is shown at *B* in the illustration.

In laying out patches previous to welding it is sometimes difficult to cut them accurately unless some such method as

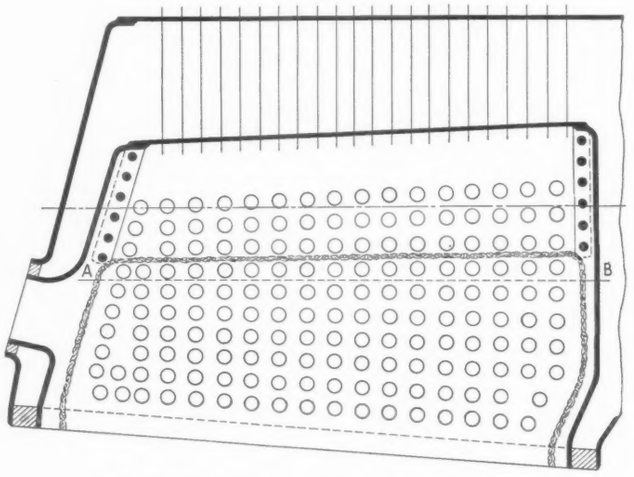


Fig. 8—Side Sheet Application; Gas or Electric

the following is used: After the sheet has been cut out and beveled, the lines *A*, Fig. 2, are scribed as shown. With the dividers set at about 6 in. arcs *B* are scribed from the edge of the bevel. When the patch is ready to lay off for size, it is bolted firmly into place, as shown in Fig. 2. The lines *A* are then scribed back on the patch a short distance. With the dividers set at the same distance used before and with the intersections of lines *A* and *B* as centers, arcs *C* are scribed on the patch. Where these arcs intersect lines *A* are points on the edge of the patch. A smooth curve is drawn through these points and the patch cut to the line. It can then be beveled and welded in place in accordance with the standard practice at local shops.

Boiler plates cracked through staybolt holes are a common occurrence and often give much difficulty before repairs can be made One method of overcoming this difficulty is illustrated in Fig. 3 in which a new circular section of boiler

plate drilled and beveled as shown at the right is applied by welding. It will be noted that the bevels are cut at an angle of 45 deg. and the weld is reinforced by adding 1/16 in. to the thickness of the original plate.

An interesting example of the method of applying mud ring and corner patches is shown in Fig. 4. This operation can be performed either by gas or electric welding, but the caution should be observed of never laying out the patch so that the weld will come lower than between the first and second rows of staybolts above the mud ring.

The method of applying a butt-welded firedoor patch is shown in Fig. 5. The corrugation to allow for expansion is shown and, as in the previous instance, the patch is beveled to an angle of 45 deg., the weld being built up an additional 1/16 in. for reinforcement.

When constant reworking of tubes and flues has damaged the flue sheet bridges, but the lower portion of the sheet is in good condition, the method of repair by welding in a new top section is shown in Fig. 6. This method effects quite a saving in time since the top flue sheet section can be more quickly laid out and formed, and the labor of cutting and reapplying staybolts in the lower section is eliminated. If any difficulty is experienced in bringing the edges of the new and old plate in alignment previous to welding, a special clamp, as shown in Fig. 7, can be used.

One of the most successful uses of welding in boiler work has been in the application of side sheets and half side sheets. The application of a full side sheet is shown in Fig. 8 with the corrugation for expansion along line *A-B*.

Characteristic Heat Treatment Curves*

BY ALBERT M. PORTEVIN AND PIERRE CHEVENARD

At the outset of a quantitative investigation of the influence of cooling, it should be pointed out that recent researches on the hardening of steel have led to the establishment with, in this instance, great accuracy, of the mutual relationship

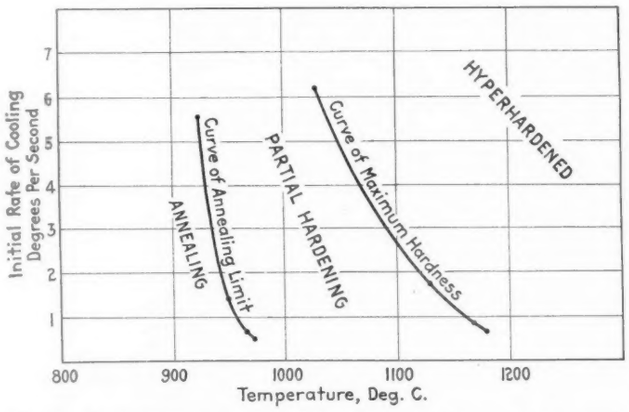


Fig. 1—Characteristic Heat Treatment of a Typical High Speed Steel: C = .40; Cr = 4.5; Tu = 18

which exists between the two fundamental factors of all heat treatment—the temperature of heating and the rate of cooling.

The final condition being a function of these two variables, it is easy to see the interest attaching to plotting a graphic representation of the result of a treatment by taking, for any given steel, these variables as co-ordinates. This method leads, as the authors will presently show, to the establishment of what they have termed the "characteristic curves" of the heat treatment of the steel in question.

*From a paper read before the September 5-6, 1921, meeting of the Iron and Steel Institute.

Characteristic Curves

By varying simultaneously the initial temperature of heating and the rate of cooling, it is possible to plot (Fig. 1) the

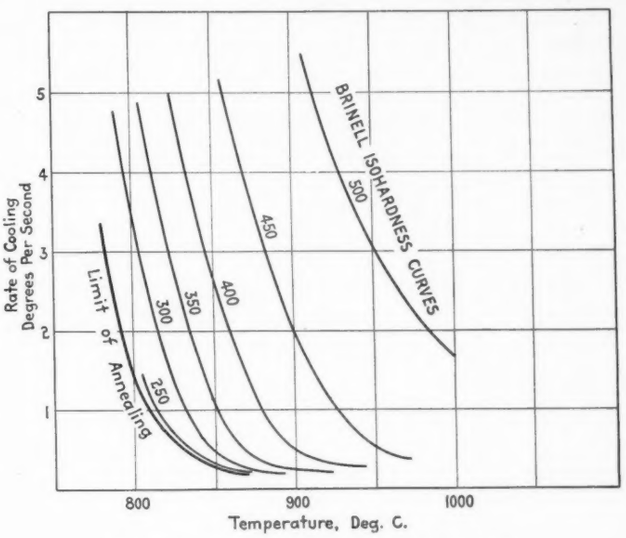


Fig. 2—Curves Summarizing Results of Tests

geometrical area of the various characteristic limits of the different states in terms of temperature and rate of cooling, taken as co-ordinates. By these means are obtained the "characteristic curves of heat treatment for the given steel." They comprise more particularly:

1. The curve of annealing limit for each rate of cooling. This curve separates the annealed states, devoid of martensite, from the hardened states, containing martensite. It is therefore the curve of the annealing limit and rigorously defines the hardening capacity of the steel.

2. The curve of maximum hardness, or of the maximum amount of martensite. This is the curve of maximum quenching, which similarly marks the limits between the partially hardened and the partially hyperhardened states.

The diagram of the characteristic curves summarizing the whole of the determinations arrived at in experiments conducted by the authors is given in Fig. 2. It comprises the curve of the limit of annealing, or curve of the critical rates of hardening, separating the region of the annealed states from that of the hardened states; and in the latter region the succession of curves of isohardness corresponding with the values of Brinell hardnesses varying from 50 to 500.

As has been said, the isohardness curves relating to hyperhardening were not taken, so that this diagram does not exhibit the curve of maximum hardness. Moreover, it cannot be hoped to collate into one plan and on one common scale the entire appearance of characteristic curves, given the considerable range of cooling rates obtainable. It is necessary to limit the inquiry, in the first instance, to the most useful and most serviceable portion, for each steel. Even within these limitations the diagram of characteristic curves furnishes a collection of facts as to heat treatments incomparably superior to the often somewhat elementary collection of numerical data hitherto accumulated in connection with the heat treatment of steels. Very often the basic considerations relating to mass and rate of cooling cannot be deduced from these observations, or expressed numerically, so that it becomes impossible to foresee what modifications may be required when the size of the pieces or the nature of the cooling medium is changed.

Numerous and important researches have now supplied data as to the cooling capacity of liquids and gases, and in order to apply them to practice there should now be plotted,

with no less accuracy, and for each type of steel, the curve showing the relationship between the rate of cooling and the effect of treatment, taking into consideration more particularly, the part played by the second of the fundamental variables—the temperature of heating.

It is to the questions raised by the latter problem that the plotting of the characteristic curves can supply answers, as they combine, in a readily utilizable form, all the data furnished as to heat treatment and are the only means of ascertaining, with any degree of precision, the hardening capacity of a given steel.

Hydraulic Rod Bushing Press

BY J. H. HAHN

Asst. Machine Shop Foreman, Norfolk & Western, Portsmouth, Ohio

A simple and effective hydraulic rod bushing press which can also be used for applying and removing driving box crown brasses is shown in the illustration. This press develops a pressure up to 70 tons and can be easily and cheaply constructed in the average machine shop, having been developed on the Norfolk & Western for use at several roundhouses and shops on the system.

A complete set of rod brasses for a 2-6-6-2 engine has been applied with the press illustrated in 35 min. Crown brasses and motion work bushings also can be applied. A pressure of 70 tons is obtained but, if desired, the cylinder can be so designed as to give a pressure of more or less than 70 tons, depending upon the requirements. Another feature of this type of press is the small amount of floor space required, as the operating cylinder and practically all piping are located under the floor.

Hydraulic pressure is supplied by a 9½-in. Westinghouse compressor, usually located at some convenient point on a bracket on the wall near the press. The air cylinder is bushed to 3¾ in. by applying a brass or cast iron bushing milled with suitable ports. The valves should be given a little more lift to handle the volume of water necessary to operate the press. Operation of the press requires no special effort as an apprentice can readily operate it after a few minutes' instruction in manipulating the various valves. A safety valve is provided to take care of any excess pressure and a pressure gage mounted on, or connected to the pressure system at any convenient point, indicates the pressure used in applying the bushings.

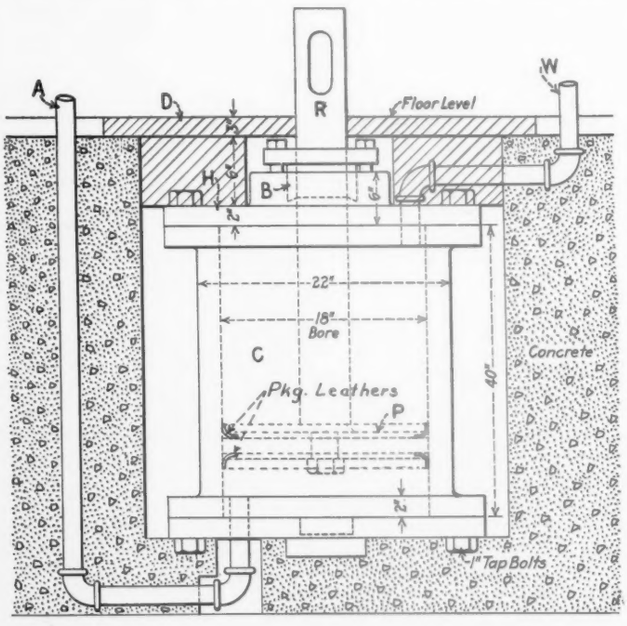


Fig. 1—General Arrangement of Hydraulic Rod Bushing Press

Referring to Fig. 1 the general dimensions of the cylinder and its method of placement in a concrete pit under the floor is plainly indicated. Cylinder head *H*, also the bottom cylinder head, is fastened to cylinder *C* by means of 12 one-inch tap bolts. It will be noted that piston *P* is equipped with double packing leathers, set in reverse directions and leaks by piston rod *R* are prevented by means of packing in stuffing box *B*. Since the press operates on the down stroke, cast iron plate *D* is provided with projections as shown to transmit the pressure from the work to the cylinder head *H*. *A* and *W* are the air and water pipes to the bottom and top of the cylinder respectively.

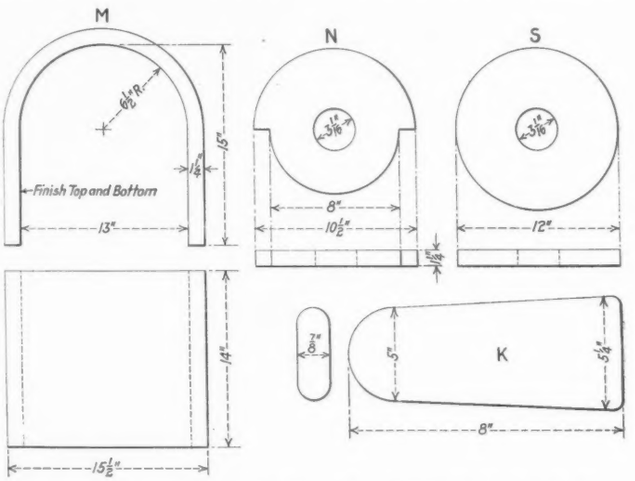
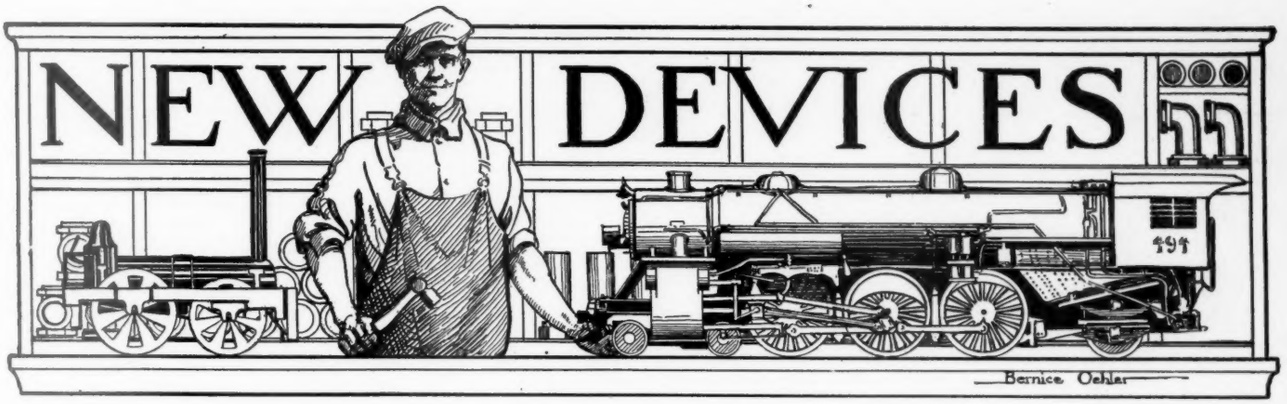


Fig. 2—Horseshoe, Plates and Taper Key Used with Hydraulic Press

Method of Operation

When applying a rod bushing in a side rod the bushing is started and a circular plate *S* (Fig. 2) applied over the end of the piston rod which has been raised by means of air pressure through pipe *A*. The proper key *K* is then applied and, with the air exhausted from under piston *P* the compressor is started and hydraulic pressure transmitted through pipe *W* to the top of the piston. This forces the piston downward and applies the bushing with a pressure indicated by the gage.

After the brass has been applied, the compressor is stopped and a by-pass valve in pipe line *W* (not shown in the illustration) opens to allow water on top of the piston to flow into the drain pipe. Opening an air valve (not shown) in line *A* will then force the piston upward and expel water above the piston through pipe *W* and the by-pass valve to the drain pipe. Sets of plates and keys are made in 6, 8, 10 and 12-in. sizes as shown at *S* and *K*, Fig. 2. For removing rod brasses the rod is blocked up a distance slightly greater than the bushing width and a plate of suitable size used to force the bushings down through the rod. For removing driving box crown brasses a horseshoe plate made of 1¼-in. stock is bent as shown at *M*, Fig. 2. The box is mounted on the horseshoe and a flat plate *N* of suitable size is used to press the old brass out of the box, also using a key as heretofore explained. The horseshoe *M* is not needed when applying the crown brasses to the boxes as the latter can then be placed directly on the cast iron plate and while in this position it is impossible to press the brasses in the box too far as sometimes happens with other types of presses. Plate *N* also is made in different sizes to suit the various types of driving boxes and is used in both cases whether applying or removing brasses. A 24-in. by 36-in. reservoir is used as a storage drum to supply air for raising the piston.



New Planer Designed for Maximum Service

THE necessity of reducing the cost of planer work by conserving every possible moment of the operator's time was the guiding thought behind the design of the new Maximum Service Planer made by the G. A. Gray Company, Cincinnati, Ohio. The novel features incorporated in its design are all intended to increase the production capacity of the machine and provide maximum ease of operation.

The method of adjusting the new Cantslip positive feed is by turning a knob at the operator's end of the rail until the required feed is indicated on the graduated dial. A partial turn of the wrist gives any feed from .01 in. to 1 in. in steps of one-hundredth of an inch. The feed dial is automatically locked as soon as the fingers are removed from the knob.

As will be seen in Fig. 1 the feed mechanism for the rail heads is mounted on the end of the rail, that for the side head is mounted on the head itself, and thus is always within convenient reach. Rail head and side head feeds are entirely independent so that one can be changed without affecting the other. Feed changes may be made while the planer is running, and changing the feed is said to be as simple as turning a door knob.

The rapid traverse embodied in these planers is applied to the side heads as well as to the rail heads. To move a head the operator simply shifts one lever. Shifting the lever disconnects the feed for that particular head, engages the rapid traverse mechanism and starts the small motor in the proper direction. Moving the lever back to neutral throws out the rapid traverse clutch, stops the motor and re-engages the feed. It is not necessary to make use of a separate starter to start the motor, nor does the motor run while not actually in use. No part of the rapid traverse mechanism is in motion unless a head is actually being moved.

As the traversing mechanism is entirely separate from the feed mechanism, one head can be rapidly set for the next cut while the other head or heads are still feeding. Throwing in the traverse mechanism automatically disconnects the hand cranks so that these do not revolve and endanger the workman. The levers for actuating the rail

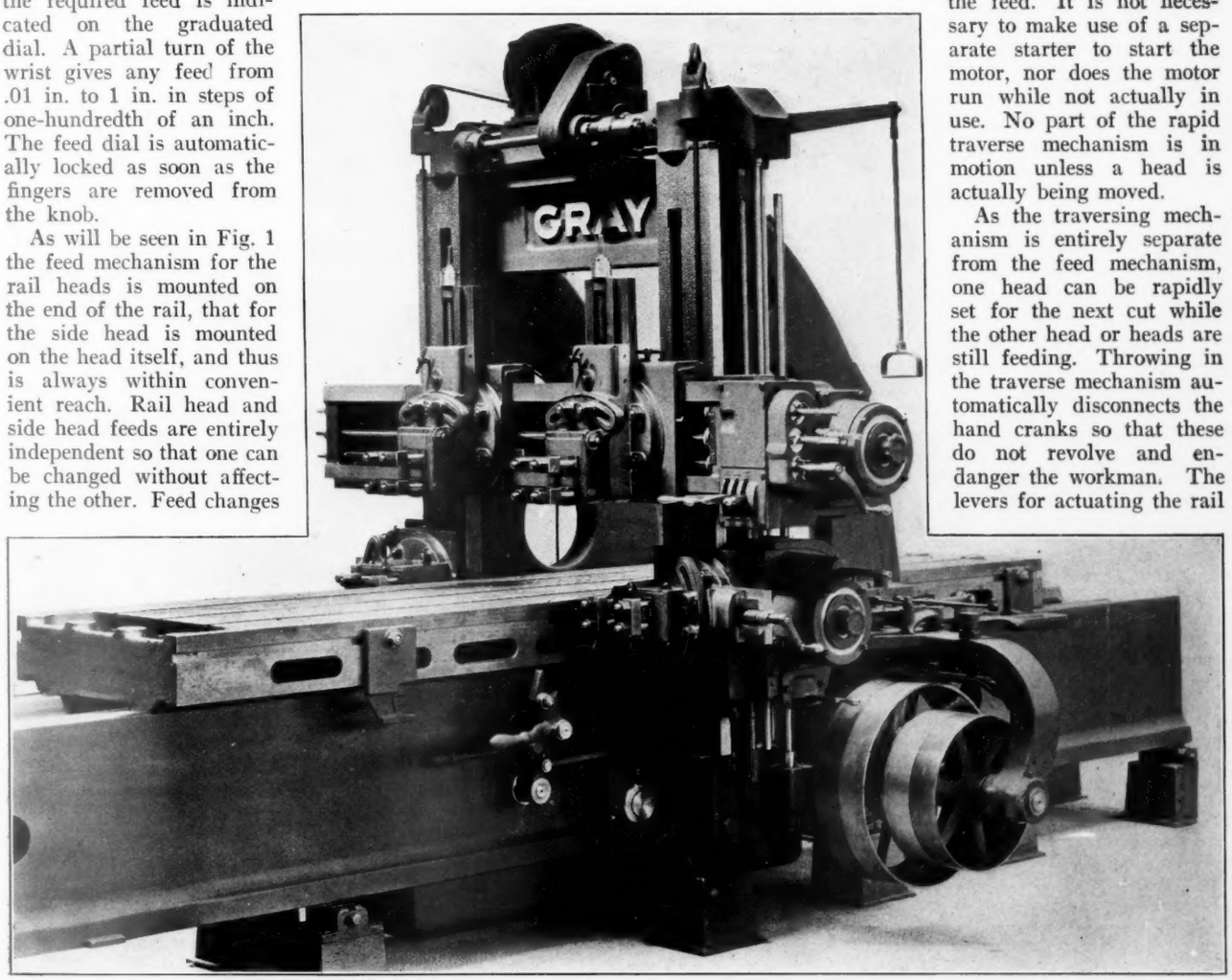


Fig. 1—Gray Maximum Service Planer Designed for Ease of Operation, Smoothness of Action and Accuracy of Finish

heads are at the end of the rail, the lever for each side head being on the head itself.

Shearing pins safeguard the traverse mechanism in case the rail heads are accidentally jammed together and safety stops obviate the possibility of lowering the side heads too far.

To elevate the rail the operator pushes up a stirrup shown hanging near the end of the rail; to lower the rail he pulls it down. The stirrup is locked in the neutral position and a quarter turn of the wrist unlocks it. As this stirrup is suspended from a universal joint, the operator can stand out in front of the rail where he can see the position of work and tools and set the rail to a line.

The motor that operates the rapid traverse also furnishes the power for the rail setter. One movement engages the elevating mechanism and starts the motor. Bringing the lever to the neutral position disengages the elevating mechanism and stops the motor. Safety stops obviate the possibility of raising the rail too high.

Turning a crank on the operator's end of the rail releases or tightens the clamps that lock the rail to the housings. The automatic adjustment positively insures that the rail is clamped equally rigidly at both ends. The rail is locked to the inside of the housings, an arrangement which greatly stiffens the rail, as it shortens the length of the rail subject to torsional stress (see Fig. 2).

As the lever operating the rail setter is also on the operator's side of the machine the planer hand can release the rail, raise or lower it and reclamp it without moving away from the operating position. Since a large investment is standing idle while the operator is going around a planer to clamp the rail, the saving accomplished by the new method is obvious.

Centralized Control

The net result of these improvements is to bring the control of practically all of the functions of the planer to the operator's usual position. Besides the raising, lowering and clamping of the rail, as described above, he can without

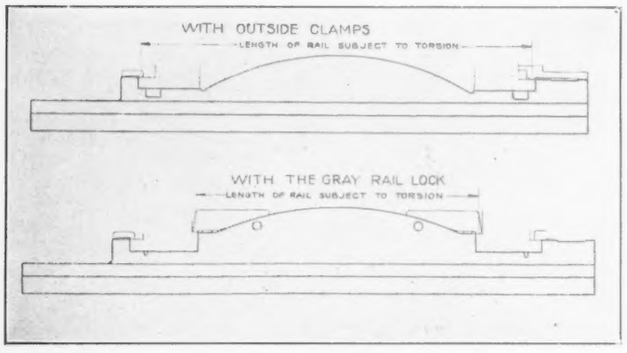


Fig. 2—View Showing Short Length of Cross Rail Subject to Torsional Stress

moving a step from his position set the feed on rail or the right hand side head; traverse either rail head or the right hand side head quickly by power; set the micrometer collars on the rail screws so as to measure accurately the travel of the tool; and, of course, use the tumbler which controls the movement of the table. In doing these things he is in position to watch his tools and so avoid the probability of serious accidents.

The bed of the new planer is made full length; that is, the working surface of the table never overhangs, even when taking the maximum stroke. In this way the table is always rigidly supported even when run way out to the front end of the planer for setting up work. By eliminating the table overhang, the wear that otherwise takes place at the ends of the bed is eliminated. The accuracy of bed and table are thus permanently maintained and better work made possible. Incidentally there is no dripping of oil on the floor from overhanging table V's, or unsightly oil pans. Both machine and floor may easily be kept clean.

The table is of box section, with an uninterrupted center wall running the entire length of the table and tying the top and bottom plates rigidly together. This design also prevents endwise springing due to peening action that occurs when heavy work is clamped. The usual transverse walls and posts are also provided. All stop-pin holes open into the cored openings of the table and are easily cleaned from the outside.

All of the driving gears run in a bath of oil so as to

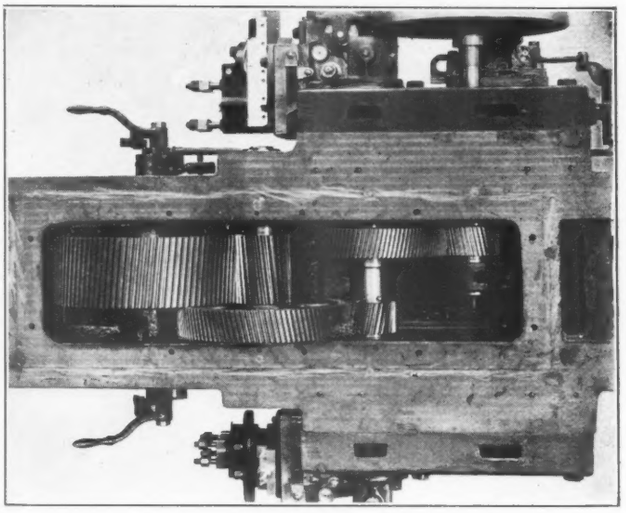


Fig. 3—Involute Helical Gear Driving Arrangement

minimize wear and prolong their life. An oil pump is direct-connected to the drive shaft and delivers a flood of oil not only to the V's but also to all of the drive shaft bearings. From the pump the oil flows through a filter, thence to a hole in each V at the center of the bed. Each table V has a large oil channel running the full length of the V but closed at the ends. From this large channel the smaller supplementary oil grooves carry the oil to all parts of the bearing surface. By this means the oil supply is kept constant at all points regardless of the relative position of the table, since the pressure is instantly transmitted through the large oil channel.

To simplify the oiling of other parts, central oil wells have been placed on rail and side heads. Oil pipes lead from the central well to the different oil holes, so that the operator merely fills this large reservoir instead of many separate oil cups. This not only saves a great deal of time, but also obviates the danger of overlooking inconspicuous oil holes. From the reservoir the oil is drawn through wicks by capillary attraction so that only clean oil reaches the bearings.

New Geared Drive Arrangement

Probably the most important part of a planer is the gearing which drives the table. The Gray maximum service planer is provided with a new system of gearing in which advantage is taken of a number of properties of involute helical gearing to produce a drive of unusual smoothness and power.

A properly designed pair of helical gears is stronger than a pair of spur gears of the same pitch and width of face. In addition to their greater strength, helical gears give continuous pitch line rolling, since there is always some point on the pitch circle where the mating teeth are in contact. Furthermore, in the case of helical gears more teeth are in

contact which in itself increases the strength and smoothness of action of the gearing.

Gray maximum service planers have helical gears throughout (Fig. 3), and advantage is taken of end thrust to cause the end thrust of the bull gear and its pinion to counteract the side thrust of the tools when cutting. Moreover, the diameters and helical angles of the remaining gears of the train are so proportioned that their end thrusts largely balance one another. Bronze thrust collars, provided with forced lubrication, take the slight residual end thrusts. Particular attention is called to the helical table rack which is of unusual width of face, giving great strength. The end thrust of the bull pinions opposes and compensates for the side thrust of the cutting tools when they are being fed away from the operating side of the machine, a condition which obtains at least 90 per cent of the time. As the tool pressure increases, the power required to drive the table and the resultant balancing thrust of the bull pinion also increases proportionately. This equalizes the pressure and wear on the two sides of the V's.

For the convenience of the operator, planer work is usually placed close to the operating, or so-called right hand side of the machine. It is therefore desirable that the line of action of the driving force should be placed slightly toward the right hand side of the machine, so that the lines of action of the cutting tool and the driving force shall coincide as nearly as possible. The rack is accordingly so placed.

The table rack is cut with a low pressure angle, thus greatly reducing the tendency of the bull gear to lift the table and making hold down gibs or other devices for preventing this action unnecessary. In order to obtain maximum torsional stiffness, reduce the strain on the shafts, and insure concentricity of the gears, the gears are not keyed to the shafts but are pressed on and keyed to the pinion bosses. The gear teeth are then cut, thus insuring not only rigid and permanent connection, but as nearly as may be absolute truth of mounting.

To insure correct tooth action, teeth of true involute form, cut by a generating process, are employed. This special form of tooth is distinguished by its full length, low pressure angle, short arc of approach and very long angle of action. The last feature greatly increases the number of teeth in simultaneous contact, reduces the specific pressure at the lines of contact, gives large and strong pinions, great smoothness of action, long life and quiet action, and produces work of great smoothness and accuracy of finish.

Welding Sets for Medium and Heavy Duty

TWO types of gasoline engine-driven arc welding sets, one for medium or intermittent duty, and the other for heavy duty, have been developed recently by the General Electric Company, Schenectady, N. Y. Both outfits are well adapted to industrial plants where the work to be done is located in odd places and is not sufficient to warrant the installation of permanent equipments. Their particular

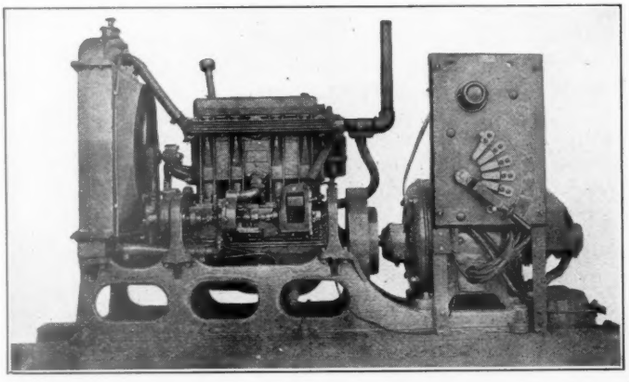


Fig. 1—General Electric Arc Welding Generator for Intermittent Duty Driven by 20-Hp., Four-Cylinder Gasoline Engine

field, however, is in places where electric power is either unavailable, inconvenient or costly to bring to the work, as at outlying points on railroads.

The medium duty equipment shown in Fig. 1 was designed particularly for intermittent duty. The generating unit consists of a type WD 10-4 kw., 1200 r.p.m., 60/20 volt, 200 ampere generator, directly connected by a flexible coupling to a Matthews, Model F, four-cylinder, four-cycle, 20-hp. gasoline engine. The engine, radiator, generator and welding panel are assembled on a rigid cast iron base which in turn is mounted on wooden skids. The set is 86 in. long, 28 in. wide, and has a net weight of about 2,000 lb., making a light and compact affair to move about. The gasoline engine used with this outfit has been especially adapted to the requirements of intermittent welding service. It is of the overhead valve type, the cylinders being cast in block with the upper half of the crank case. The lubrication is a combination of splash and force feed, except where special conditions require the addition of a pump which is driven by the accessory shaft.

The generator is self-exciting and regulating, giving practically constant energy throughout the working range. It gives a no load, or striking voltage of 60 which automatically decreases to the proper welding voltage (usually 18 to 20 volts) when the arc is struck. It is driven at a speed of 1200 r.p.m., has a normal output of 4 kw. and delivers a maximum working current of 200 amperes. The panel carries the generator field rheostat and series field dial switch by which the current can be adjusted from 200 to 75 amperes in 25 ampere steps. A reactor choke coil mounted on the set and connected in the welding circuit protects the generator from current surges.

The heavy duty equipment (Fig. 2) can be arranged to

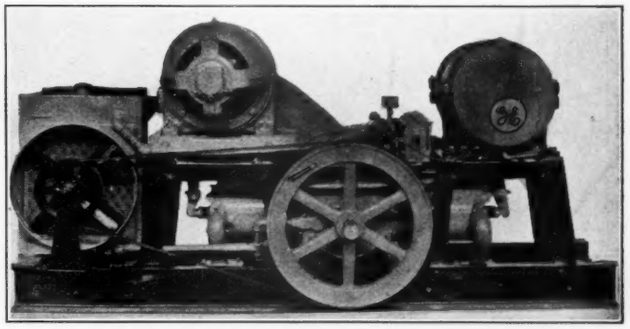


Fig. 2—Heavy Duty, Arc Welding Set, Driven by 20-Hp., Two-Cylinder Kerosene Engine

supply either one or two welding circuits. It consists ordinarily of a 20-hp. two-cylinder opposed Reliable gasoline engine, a type WD 9 generator and welding panel, the whole mounted on a welded structural steel base with a net weight of 2,400 lb. for the single operator equipment and 3,200 lb. for the double operator equipment.

The gasoline engine is designed for continuous operation at rated output. Careful balancing practically eliminates vibration and the horizontal cylinder and relatively small fly-

wheel makes possible a compact assembly with the rest of the outfit. It is said to run on kerosene, distillate, gasoline or natural or artificial gas, with a fuel consumption per brake horsepower not exceeding one pint of kerosene, distillate or gasoline, 10 to 12 cans of natural gas, or 17 to 22 ft. of average illuminating coal gas.

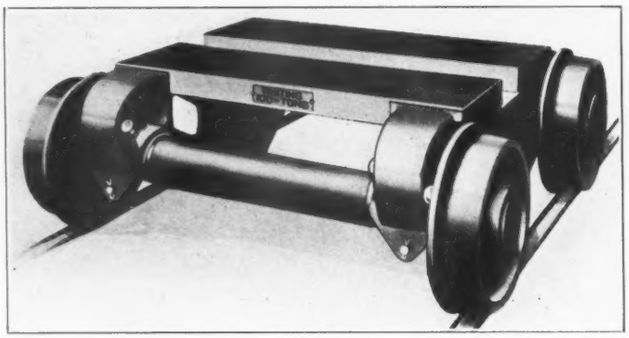
The generator is driven by a silent chain running in oil, and except for the speed, its characteristics are similar to the WD 10 generator which forms part of the medium duty outfits. The speed is 1750 r.p.m. instead of 1200 r.p.m. and the motors differ somewhat in the windings because of the difference in speed and service requirements. An ammeter is mounted on the panel of each heavy duty equipment, but in other respects they are identical with the medium duty sets.

One Hundred-Ton Locomotive Shop Truck

WHERE the Whiting hoist is used for wheeling and unwheeling locomotives it is customary to provide some form of four-wheel truck applied to the rails under the front and back ends of the locomotive for its subsequent movement to the place where repairs are to be made. It is essential that these trucks be of extremely rugged construction and so designed as to eliminate friction as far as possible and make movement of the locomotive reasonably easy. The truck shown in the illustration has been developed primarily for this purpose by the Whiting Corporation, Harvey, Ill., but may also be used to advantage for transferring unwheeled locomotives where cranes are employed for the purpose of unwheeling.

The sides of the truck are heavy steel castings connected by structural members to form a rugged unit. The frame is mounted on a steel axle provided with heavy steel wheels. Special attention has been paid to the design of the bearings, which are of liberal size and lubricated in such a way as to reduce friction as much as possible. This is an important point.

The truck is designed for a load of 100 tons with a liberal factor of safety and its rugged construction makes it of special value for the purpose for which it was designed.



Whiting 100-Ton Locomotive Shop Truck

Hose Dismantling and Assembling Machine

THE machine illustrated has been designed for the single purpose of dismantling and assembling air, signal and steam hose used in railroad service. It is a self-contained, air-operated machine, which needs no special foundation and can be set up on the shop floor, under a shed or in any location convenient to an air line with from 85 to 100 lb. pressure.

The machine consists of body *A* (Fig. 1), mounted on three pairs of legs, and equipped with three cylinders; cylinder *B*, operating the special shear knives *C* for cutting clamp bolts; the main cylinder *D* for operating cross-heads *E* and *F* which carry the dismantling and assembling tools; and cylinder *I* (Fig. 2) in the rear of the machine for operating the head *G*. This head clamps old hose for stripping (Fig. 3) and with the trough jaws *H* and *J* (Fig. 4) holds new hose in alinement for assembling. A bumper box which ab-

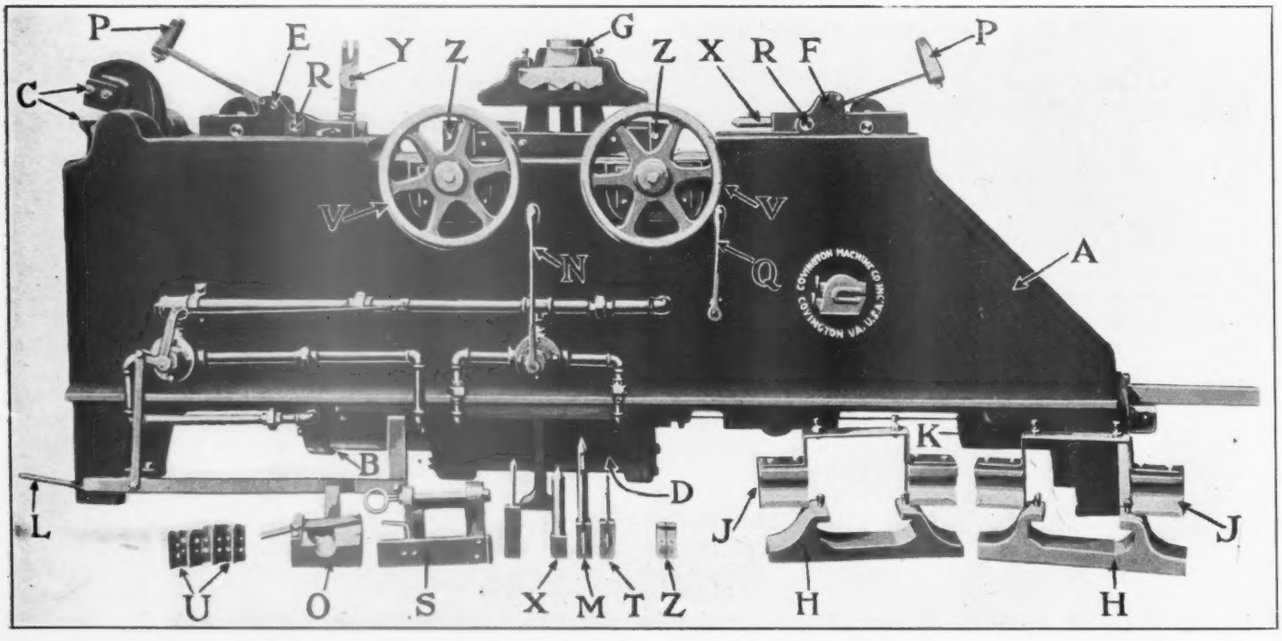


Fig. 1—General View of Covington Machine for Dismantling and Assembling Air, Signal and Steam Hose

sorbs the shock when stripping old hose is shown at *K* (Fig. 1).

With this machine, which is heavily built for hard and constant service, nipples, couplings and clamps are stripped from old hose and assembled on new hose over and over again. No fittings are injured in any way, the only loss being the clamp bolts which are cut in dismantling, and these bolts, due to rust, are scrap in any case.

The Dismantling Operation

The operation of the machine for stripping old hose is as follows: Referring to Fig. 1, clamp bolts are first cut

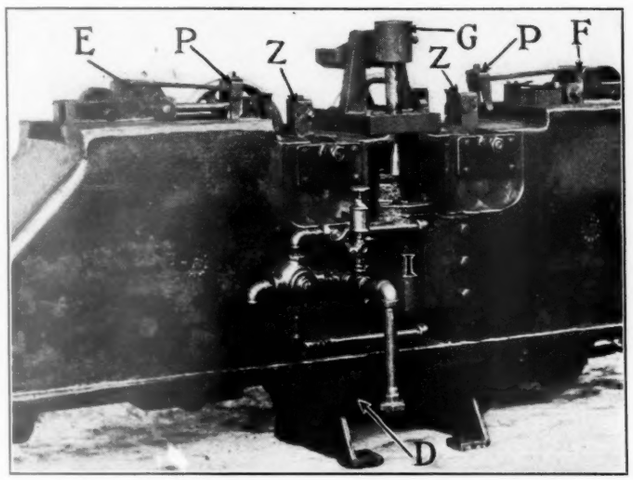


Fig. 2—Rear View Showing Cylinder Which Operates Hose Clamping Head

under special shear knives *C* without injury to hose clamps, the valve controlling this operation being operated by the foot treadle *L*, thus leaving both hands free to hold the hose. On a test, one operator is said to have cut both clamp bolts from 140 hose in 20 min.

After cutting the clamp bolts, the nipple end of the hose is placed over the nipple puller *M*, which can be placed in

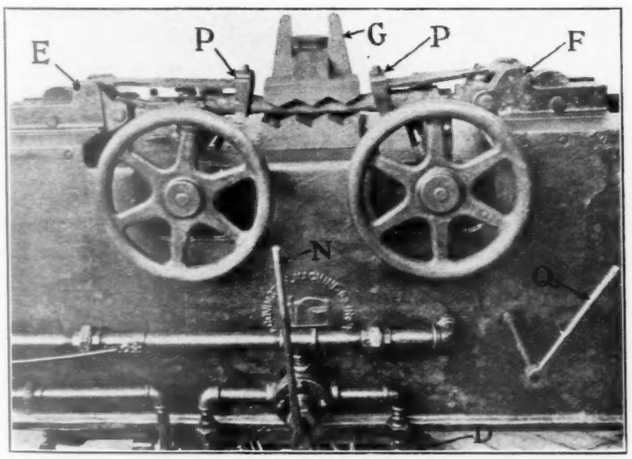


Fig. 3—Machine Equipped for Stripping Clamps and Fittings

crosshead *F;* the operating lever *N* is moved to the left, bringing crossheads *E* and *F* toward the center of the machine. The coupling end of the hose is then dropped into the coupling puller *O* placed in crosshead *E;* both clamp pullers *P* are dropped down over the hose in back of the clamps; the operating lever *Q* for the clamp cylinder is moved to the right clamping the old hose between serrated head *G* and a serrated block on the frame, as shown in Fig. 3. The separating lever *N* is moved to the right admitting air to the cylinder *D;* both crossheads draw back at the same time, pulling out both nipple and coupling together with the clamps without injury to fittings or clamps. The whole operation requires less time than it takes to describe it and one operator is said to have dismantled 140 hose in 40 min.

The operation of stripping air, signal or steam hose is exactly the same, the changes in tools for different hose being made very quickly. The pins *R* (Fig. 1) being pushed out, the tools already in the crosshead can be removed and others substituted.

Air and signal hose are handled by the same coupling puller; for steam, the coupling puller *S* is used. The same nipple puller *M* for air and steam hose is used; for signal hose, the one at *T* is substituted. Many hose are cut or pulled in two parts making short ends. These are handled as easily by the Covington machine as whole hose, by using the short end pullers *U*.

Assembling New Hose and Fittings

In assembling, special trough jaws *H* and *J* (Fig. 4) are placed over the serrations on the clamp head *G* and clamp block on the frame. A new hose is laid in this trough and the operating lever *Q* pushed to the right, bringing the head *G* with trough *H*, down on block *J* holding the new hose straight and in line without any clamping which would possibly injure the hose.

The hose clamps are placed in position, the nipple centered and held on plug *X* and the coupling placed in the fixture *Y*. The ends of the fittings are swabbed with rubber cement as usual, then the operating lever *N* is moved to the left, bringing both crossheads *E* and *F* towards the center of the machine, forcing both fittings into the hose at the same time. Due to the centering devices for both the hose and fittings, no injury is done to new hose. All heads are then released and the hose clamps brought together by means of the handwheels *V* and jaws *Z* (better shown in Fig. 2). The clamp bolts are then put in place and nuts screwed on, thus completing the assembling operation.

The speed of the machine depends largely on the operator's willingness to work. On a test, an operator cut the clamp bolts and dismantled 140 air hose in 60 min. Out of the 140 hose, 15 short ends were pulled due to bursted hose pulling in half, necessitating using the short end puller. The time taken to cut the clamp bolts from 140 hose was 20 min.;

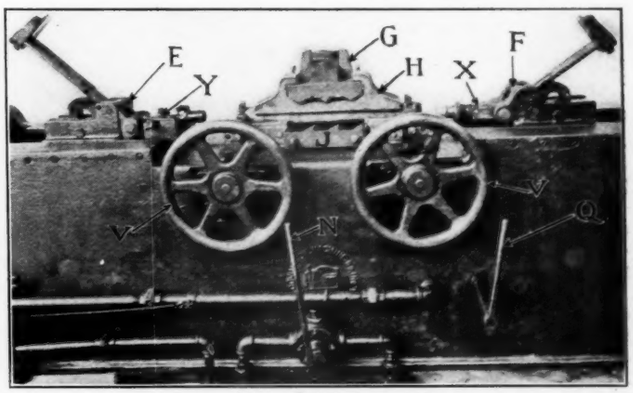


Fig. 4—Arrangement for Assembling Hose, Clamps and Fittings

to dismantle the 140 hose, 40 min. In the pile of couplings, nipples and clamps not one was injured in any way, but all were ready to be cleaned and assembled into new lengths of hose.

In the assembling test one operator took the new lengths of hose, put on clamps, forced the coupling and nipple in the new hose, squeezed up the clamps, inserted clamp bolts and put on the nuts of 30 air hose ready for service in 60 min. The time taken to assemble each hose ready for clamp

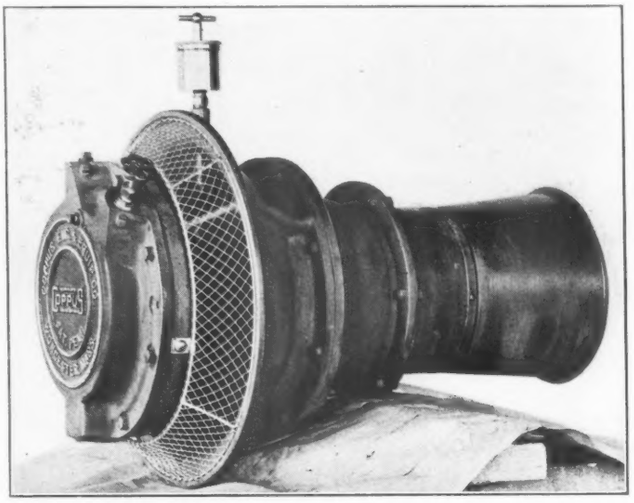
bolts averaged 30 sec., and the balance of the time, or 1½ min. for each hose was taken in squeezing up clamps, putting in bolts and running up the nuts. Most of the time is consumed in putting in the clamp bolts on the assembling operation.

The dismantling can be speeded up when great quantities of hose are handled by having one operator on the shear end cutting clamp bolts, while another operator is stripping the hose, as each operation is independent. This, however, is hardly necessary since, as shown by the test, the rapidity is such that one man can usually handle, unassisted, all the work of this nature in the average shop. The statement is made that any workman of average ability can become an experienced operator within ten days. All operating levers and handwheels are in easy reach and convenient for the operator. The Covington hose dismantling and assembling machine is manufactured by the Covington Machine Company, Inc., Covington, Va.

Propeller-Type Blower of Novel Design

THE screw blade, propeller-type blower, shown in the illustration, is made by the Coppus Engineering & Equipment Company, Worcester, Mass., the principal new feature of this design being a stationary guide vane beyond the propeller so arranged that the air current on leaving the propeller is radially subdivided by the individual guide vane blades and taken up by them without shock. These blades have a curvature increasing in the direction of rotation of the propeller and concentrate the air current, giving it a further acceleration inside of the stationary guide vanes so that a considerable part of the pressure is obtained in the latter. The end thrust is therefore mostly taken by the stationary guide vane casing.

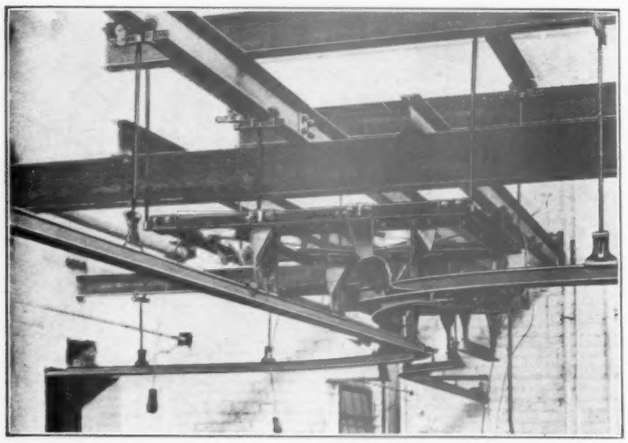
Moreover, the delivery of air in this blower is parallel to the axis. In other words, the air leaves in the same direction as it enters and in the case of long pipes subject to leakage two or more blowers can be installed between the ends, thus delivering a positive flow of air at low pressure and small resultant leakage. It is claimed for this propeller blower that its efficiency runs up to 80 per cent; that the power consumption at constant speed is practically unaffected by variations in air delivery or pressure and that the blower can operate against pressures up to eight inches of water. On account of these advantages, the blower is adapted to use in providing forced draft, induced draft, main and individual room or tunnel ventilation, air heating and drying installations, cooling of electric motors and generators, ventilation of factories, boiler rooms, etc.



The Coppus Blower Receives and Delivers Air Parallel to the Axis

Overhead Handling System Lowers Shop Costs

IN the efforts towards reducing costs of railway shop operation mechanical devices are taking an important part. In repair shops, machine shops, etc., where floor space is at a premium the overhead methods of handling—cranes, monorails, tramrails, etc.—offer important advantages. For use in such shops the Cleveland Crane & Engineering Company, Wickliffe, Ohio, has developed a tramrail which may also be used with success in freight terminals where the overhead method provides the answer to the handling problem.



The Curves in the Rail Illustrate the Flexibility of the Tramrail System

The feature of this system, which is the flexibility of the installation of the rail, is evidenced by the methods of suspension. These consist of hanger rods, brackets and rail clamps which can be attached to the purlins of a building or almost any support available. For all loads up to the maximum capacity of two tons the rail support clamps are placed three feet apart.

The system is standardized and a mechanic can layout, order and install the rail, rail fittings, switches, turntables, carriers, etc. By the use of cold bends in the rail any curve down to a 4-ft. radius can be made without sacrifice of safety. The bend is easily made by the use of a special bending device.

Like the other units of the system, the switches designed for this tramrail are standard. The same switch is installed for hand power or electric operation, thus permitting a hand power system to be electrified at any time. In this switch, both the stationary and movable rail are held in firm contact, eliminating the open space at the point where the rails join. Safety has been given special attention with the result that the instant a switch is opened a safety stop drops on the rail, preventing the carrier from passing that point. When the switch is in position it is automatically locked, thus preventing the carrier and its load from sliding the

switch out of alinement. When additional safety is desired, the installation of trolley wire insulator makes it impossible for an electrically driven carrier to run at full speed against a safety stop or open switch.

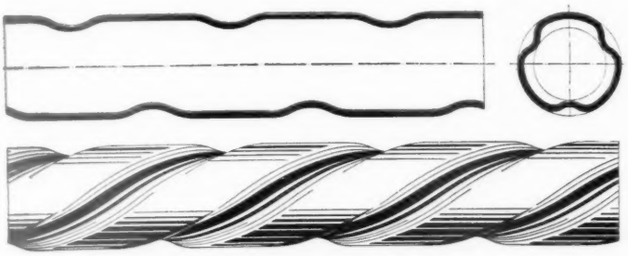
In an installation it is often found necessary to install the rail at different levels. This means that the carriers must negotiate a grade. Up to a grade of 12.5 per cent the electrically driven carrier has ample power to operate with its full load. This makes the employment of a brake essential, which is fully met by a foot brake which is provided only on carriers traveling a grade. Where the difference in levels is greater than it is practical to climb, an ordinary freight elevator is installed with the tramrail. This method safely lifts or lowers the carrier and load to the desired level without rehandling and requires but one man.

By the use of a central control system several carriers can be operated by one man. Where an unobstructed view of the system is not possible, the operator is informed as to the location of the carriers he controls by signal lights on a board before him. With this arrangement the dispatcher can switch the carrier to any track or location desired.

Through combinations 1,200 types of carriers are possible with the standard equipment. An important innovation of this system is the manner of installing the tramrail transfer bridge which gives accessibility to every point on the floor. A standard rail, installed along the length of the building on both sides, forms the runway for the transfer bridge which permits the carriers to operate from the tramrail track onto the bridge. Working parts are fully enclosed so that fumes, moisture and dirt cannot shorten their life. The ball bearings and other bearings of bronze graphite inserted bushings with ample provision for self lubrication are so placed that if it becomes necessary to remove them they are readily accessible.

New Type of Spiral Boiler Tubes Developed in Sweeden

SPIRAL boiler tubes of round section and of a form which might be called a single thread of small pitch have been used to a limited extent in European locomotives for many years. While they have often shown economies during tests, they have frequently failed to maintain such economies after continued service and their use has been discontinued in most places. The reason for their failure to meet expectations is apparently due to a large extent to their form and the small pitch which considerably increase the resistance to the passage of the smoke gases and in addition afford pockets in which the soot lodges, consequently reducing the heating efficiency of the tubes.



"Ess" Spiral Boiler Tube

In an endeavor to overcome these faults, Nordling and Bengtzon of Amal, Sweden, brought out a few years ago a new form of spiral tube known as the "Ess" tube which is manufactured by the Uddeholms Aktiebolag, Uddeholm, Sweden. As will be noted from the illustration, the cross-section is of a circular form broken by three wave-like recesses while the pitch is about eight inches. This form offers less frictional resistance to the gases than the older form of spiral, has 90 per cent of the cross-sectional area of the round tube and a slightly greater heating surface. It imparts to the gases a rapidly whirling motion and experience has shown that it is practically self-cleaning.

It is also claimed that this form of tube is a reliable spark extinguisher, the larger particles being broken up during their passage through the tubes. Several hundred coal-burning locomotives equipped with these tubes are operated in Sweden without other spark arresters, although with low exhaust nozzles a small deflector is attached to the front tube sheet. This practice is possible with the rates of combustion and amount of draft there used even though the same practice could not be followed under the conditions prevailing in American locomotive operation.

In superheated steam locomotives the flow of gases must be properly divided between the small heating tubes and the large flues containing the superheater elements in order that the desired degree of superheat may be obtained. In locomotives equipped with spiral heating tubes, it has been found advisable to twist the superheater elements into a screw shape, two or three turns ordinarily being sufficient for European conditions. By so doing the flow of gases through the tubes and flues is equalized and a rotating action is also

COMPARATIVE RESULTS OF BOILER TUBE TESTS

Locomotive type	0-6-0		0-8-0			4-6-0	
Service	Freight		Freight			Passenger	
Weight on drivers	70,350 lb.		110,250 lb.			81,600 lb.	
Total weight of engines	70,350 lb.		110,250 lb.			125,250 lb.	
Cylinders, diameter and stroke	17 in. by 24 in.		21⅝ in. by 25⅞ in.			20½ in. by 24 in.	
Grate area	15.1 sq. ft.		23.7 sq. ft.			25.8 sq. ft.	
Tubes, number and diameter	186-1⅞ in.		127-1⅞ in.			127-1⅞ in.	
Flues, number and diameter	.....		21-5 in.			21-5 in.	
Tubes and flues, length	9 ft. 9 in.		13 ft. 11 in.			13 ft. 11 in.	
Test number	1	2	3	4	5	6	7
Kind of tubes	Plain	Spiral	Plain	Spiral	Spiral	Plain	Spiral
Superheater units	.....	.....	Straight	Straight	Spiral	Straight	Spiral
Firebox	.....	.....	Copper	Copper	Steel	Steel	Copper
Length of run	219 miles	219 miles	219 miles	219 miles	219 miles	209 miles	209 miles
Time of run	12 hr. 59 min.	13 hr. 14 min.	13 hr. 22 min.	13 hr. 22 min.	13 hr. 22 min.	6 hr. 24 min.	6 hr. 24 min.
Coal burned	10,212 lb.	8,362 lb.	13,944 lb.	11,851 lb.	10,553 lb.	7,687 lb.	7,284 lb.
Draft in smokebox water column	.....	.....	3¼ in.	2⅜ in.	2⅛ in.	3⅛ in.	3⅜ in.
Temperature gas from tubes	630 deg. F.	410 deg. F.	545 deg. F.	406 deg. F.	433 deg. F.	669 deg. F.	520 deg. F.
Temperature gas from flues	.....	.....	507 deg. F.	475 deg. F.	450 deg. F.	565 deg. F.	500 deg. F.
Boiler water temperature	351 deg. F.	352 deg. F.	358 deg. F.	360 deg. F.	356 deg. F.	374 deg. F.	372 deg. F.
Superheated steam temperature	.....	.....	504 deg. F.	518 deg. F.	514 deg. F.	536 deg. F.	559 deg. F.
Water evaporated per pound of fuel	6.73 lb.	8.26 lb.	8.4 lb.	9.3 lb.	10.1 lb.	8.06 lb.	9.41 lb.
Increased boiler efficiency, per cent	.....	22.8	.....	10.7	20.2	.....	16.7
Saving in fuel, per cent	.....	18.5	.....	9.7	16.8	.....	14.4

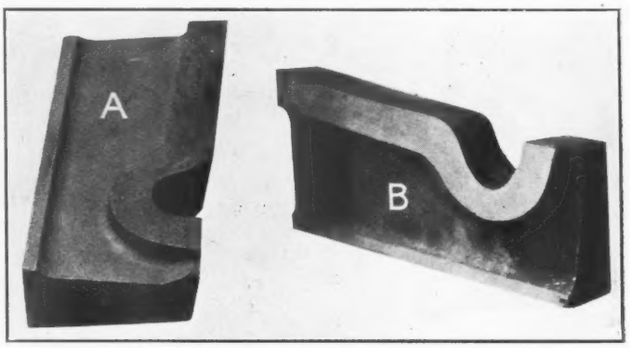
imparted to the gases passing through the superheater flues, thus adding still further to the efficiency of the boiler.

Repeated tests have been made with both saturated steam and with superheated steam locomotives in passenger and freight service. In all cases the locomotives compared differed only in tubes and in form of superheater elements. The results of a few of these tests, shown in tabulated form, indicate the savings obtained.

Drop Forged Cutters for Wheel Lathes

THE forming of blanks for various types of milling cutters by the drop forging process possesses a number of advantages over the use of full size bar stock. Principal among these may be mentioned the refinement of structure resulting from the additional working of the material, the attainment of a higher degree of homogeneity in the structure of the material than is possible in large bar sections and the saving in the amount of material removed in the finish.

The drop forging process has been applied with similar advantages to the manufacture of large forming tools for wheel lathes. It has been claimed that high speed steel cannot be forged in this manner but bold indeed is the man who will put his finger on any single operation and say to the American manufacturer, "This cannot be done." High speed cutter blanks for side mills, end mills, hobs and many special tools are being successfully drop forged. The illustration shows a drop forged wheel lathe forming tool blank *A* and the finished tool *B*, from which it is evident that the only work required to finish the blank is a comparatively small amount of grinding. These blanks are made by the Forge Products Corporation, Ann Arbor, Mich.



View of Cutter Before and After Grinding

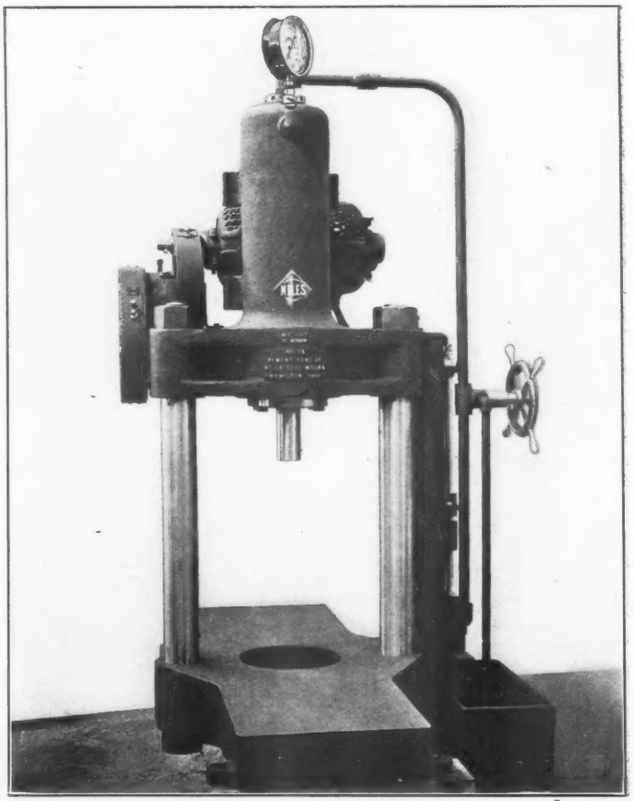
Hydraulic Driving Box and Rod Bushing Press

THE hydraulic press illustrated has been developed by the Niles-Bement-Pond Company, New York, as a quick and convenient means of pressing brasses into or out of locomotive driving boxes. It is also particularly adapted to applying and removing rod brasses and other similar work. The base plate for supporting the work is tied to the cylinder by heavy steel tie bolts. The ram moves downward by hydraulic pressure from a power driven pump forming part of the machine.

The base plate is planed on its top surface and has a hole at its center to permit the passage of shafts or bushings which are being pressed out. This hole can be made to conform in shape and size to the requirements of the work. The steel tie bolts are shouldered to maintain the distance between the base plate and the resistance head.

The cylinder is lined with copper expanded into place and burnished. The piston is packed with cup leather, being tight and durable and causing little friction. The driving mechanism is mounted on the cylinder and is geared to a horizontal shaft which drives the pump located at the side of the press convenient to the operator. The pump has one or two plungers in accordance with the power of the press. Safety valves are provided for each pump plunger and can be set to release at predetermined pressures. The design of the pump is such that any plunger can be instantly thrown into or out of operation. A hand wheel operates a release valve which when opened permits the water to flow back into the pump suction tank, provision being made for automatically raising the ram upon the release of the pressure. A gage is provided which indicates the pressure on the ram in pounds per square inch and the total pressure in tons. The drive can be either by belt through tight and loose pulleys or by direct attached constant speed motor for direct or alternating current.

The length of the 50-ton press base plate is 60 in., the width between tie bolts being 22½ in. The stroke of the ram is 13 in. and the maximum allowable height of work 26 in. One pump plunger is used, approximately five horsepower being required to drive the press. The base plate of the 100-ton press is 60 in. in length, the width between tie



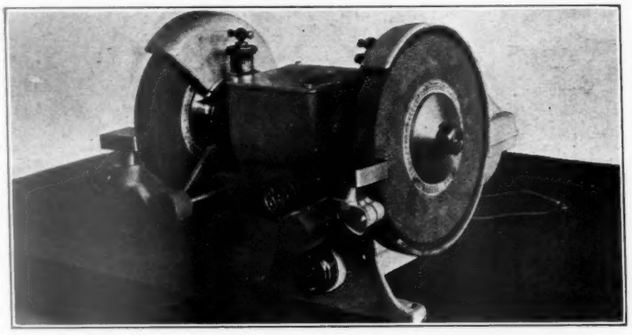
Niles-Bement-Pond 50-Ton Press

bolts being 28½ in. The stroke of the ram, as in the case of the smaller press, is 13 in., but work 36 in. high can be accommodated under the ram. Two pump plungers are used and a 7½-h.p. motor is required to drive the press.

The 100-ton press is regularly equipped with a swiveling crane mounted on an extension of the base plate and supporting a chain hoist of 2,000 lb. capacity. Such a crane can be supplied on the 50-ton press to order only.

Eight-Inch Electric Bench Grinder

THE Black & Decker Mfg. Company, Baltimore, Md., announces a new model grinder known as the Eight-Inch Electric Bench Grinder. This is a substantial two-wheel grinder, driven by a ¾-h.p. motor of the universal type similar to motors used in Black & Decker portable electric drills. It operates on alternating or direct current at will. Among the interesting features of this new model is the arrangement of the grinding wheels, which are set well forward of the motor casing and arranged so that they overhang the bench. This makes it possible to grind long pieces and odd shapes with unusual facility and also makes it possible to wear the grinding wheels down to the clamp washers, thus avoiding wheel wastage.



Black & Decker 8-In. Bench Grinder

The motor is air-cooled and arranged so that the air intake is located 12 in. from the grinding wheels in order to reduce the possibility of grit being drawn into the machine. The machine is grease lubricated throughout.

The grinder is furnished complete with two grinding wheels, one coarse and one fine, 8 in. in diameter and ¾ in. wide; two wheel guards, two adjustable tool rests, an electric cable fitted with attachment plug and switch. A grinder of this type is particularly adapted to use in machine shops, and when installed at convenient locations on the benches will undoubtedly save many steps and a large amount of time formerly spent going to grinders located at a distance.

Recent Improvements in Adjustable Crosshead

EXTENDED use on several classes of large freight and passenger locomotives has demonstrated the value of the adjustable crosshead, made by the Rogatchoff Company, Baltimore, Md., and described on page 1619 of the June 9, 1920, Railway Age. Since the publication of that article, however, the crosshead has been altered in two respects which, while apparently simple, increase the possible adjustment of the crosshead and reduce the cost of one of the machining operations.

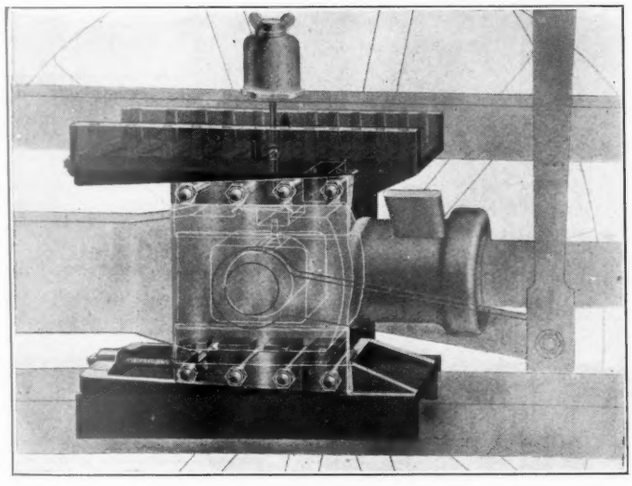


Fig. 1. General View of Rogatchoff Adjustable Crosshead

Reference to the original description of the Rogatchoff crosshead shows that only one adjustable taper wedge was used, this being provided on the bottom shoe. In order to increase the possible range of adjustment and compensate for a greater wear of both guide and crosshead shoe, a second case-hardened wedge has been applied to the upper crosshead shoe as shown in Fig. 1. By these two taper wedges an adjustment of approximately 7/16 in. can be obtained.

Reference to the end view in Fig. 2 shows that the part of the shoe extending between the crosshead sides has been machined with straight parallel sides, whereas the original shoe was provided with taper sides at this point. The elimination of the taper is a considerable advantage from the point of view of reduction in machining cost and greater ease in applying the shoes. It is also in accordance with the usual practice in making crosshead shoes.

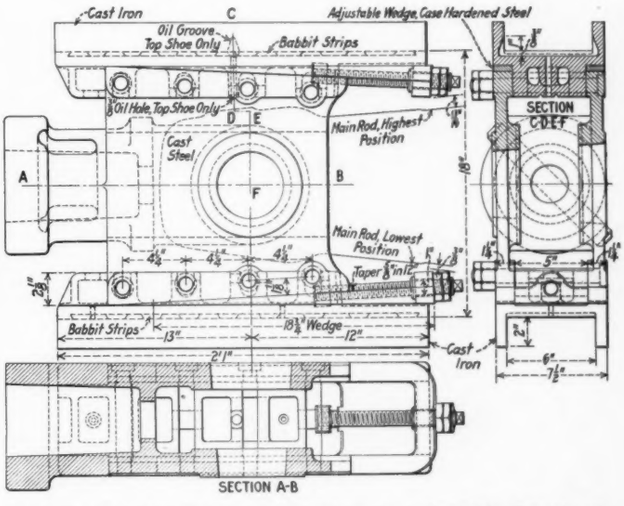


Fig. 2. Drawing Showing Alterations in Adjustable Crosshead

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WE GUARANTEE, that of this issue 7,500 copies were printed; that of these 7,500 copies 6,743 were mailed to regular paid subscribers, 10 were provided for counter and news company sales, 227 were mailed to advertisers, 8 were mailed to employees and correspondents and 512 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 108,100, an average of 9,008 copies a month.

The *Railway Mechanical Engineer* is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.)

Seven hundred men returned to work after a long lay-off when the Chicago Great Western shops at Oelwein, Iowa, were opened on October 16.

A fire at Mobile, Ala., on October 26, destroyed 21 cars in the Mobile & Ohio yard. Estimated loss, $25,000. Sparks from a locomotive are given as the cause.

One hundred and fifty additional men are to be added to the New York Central locomotive shop forces at West Albany, N. Y., this increase in force to take place as fast as competent men can be obtained.

The Norfolk & Western reports the total number of persons killed on that road in 1920 as 84; a figure which marks a remarkable decrease from 1912, when the total was 229; while at the same time there has been a steady increase in the volume of freight traffic.

The Interstate Commerce Commission has issued Accident Bulletin No. 78, containing the record of collisions, derailments and other accidents on the railroads of the United States for the last quarter of 1920, and also for the 12 months ending with December. The number of passengers killed in train accidents in the twelve months was 95, as compared with 110 in the preceding year; and of employes, 430 as compared with 366.

J. E. Fairbanks, general secretary, has sent out a blank for the letter ballot under which members of the American Railway Association are to vote for members of the board of directors; and in connection therewith, by circular No. 2200, the directors recommend, for the better geographical representation of members on the board, that the number of directors be increased from 18 to 21. This involves changes in article 7 of the constitution and sections 3, 5 and 19 of the by-laws.

The Chicago, Rock Island & Pacific has started preparations for the celebration of its seventieth anniversary which occurs on October 10, 1922. Inquiries have recently been sent to the various employes associations and officers of the company asking that suggestions and plans be submitted for a fitting commemoration of the occasion. It has already been suggested that the first Rock Island train, which made its initial run between Chicago and Joliet, Ill., in 1852, be re-constructed.

The Elmira Division of the Pennsylvania Railroad reports that for a period of 56 days, August 13 to October 7, there was not a single minute's detention to a passenger train on the division due to engine failures. For a period of 39 days, August 28 to October 6 inclusive, there were no delays from car failures. In making this record 752 trains were operated a total distance of 69,154 miles. Ninety-seven per cent of the trains maintained schedule time. This division is 143½ miles long, and contains many sharp curves. There are two long and steep grades of two per cent each, in both directions.

John E. Oldham, of the Boston banking firm of Merrill, Oldham & Co., is sponsor for a new plan of railroad consolidation. Mr. Oldham's plan which differs greatly from the plan made public by the Interstate Commerce Commission on September 28, was presented at the convention of the Investment Bankers' Association of America at New Orleans, La., on November 1. It has also been published by that organization in a booklet of 64 pages illustrated with 13 insert maps in colors.

Walker D. Hines, formerly director general of railroads, on his recent return to this country, after having spent over 16 months in Europe, said that railroad transportation conditions had been improved much more in France than in eastern Europe, where there has been much confusion resulting from the delays in allocating the rolling stock that was seized and otherwise scattered during the war. This has led to much trans-shipment at the frontiers and has resulted in stimulating the river traffic.

The Executive Committee of the Railway Supply Manufacturers' Association met at the Waldorf-Astoria Hotel, New York City, October 26, 1921. The situation was thoroughly discussed regarding the meeting and exhibits of the Association for 1922. The letter ballot as to the preference of all members indicated a three-to-one vote in favor of the meeting and exhibits. The letter ballot and reports from the various members of the committee representing all parts of the United States, showed also that the members were decidedly in favor of going to Atlantic City for the meeting and exhibits. A formal vote was taken and it was unanimously decided to hold the 1922 meeting and exhibits in Atlantic City, New Jersey.

German Locomotives for Spain

It is reported that four German-built locomotives, each of a total weight of 96 tons, have been delivered at Port Bon, Catalonia, Spain, for use on the Madrid, Saragossa & Alicante railway. Twenty-one similar engines are on order.

German Rolling Stock Allocated to Danzic Territory

The following German rolling stock has recently been definitely allocated to the Danzig territory by the Interallied Commission sitting in Berlin, according to a report from Consul William Dawson: locomotives, 116; passenger cars, 172; baggage cars, 35; freight cars, 1,950; and electric locomotives, 2.

Russian Shipyard to Repair Locomotives

It is reported that the Balto-British Shipyard Company, Reval, Russia has undertaken the repair of one thousand locomotives for the Russian railways during the next five years.

Increase in Value of Exports of Electric Locomotives

During the first nine months of 1920, electric locomotives valued at $844,130 were exported from this country, according to Commerce Reports. In 1921 for the same period the value of electric locomotives exported was $1,506,877.

South Manchuria to Buy Supplies Here

The South Manchuria Railway plans to spend approximately $20,000,000 annually in the United States, during the next few years for railway equipment and supplies, according to the New York Evening Post, which ascribes the statement to Yozo Tamura, an officer of the company, who recently arrived from Japan.

Bangor & Aroostook Leases Car Shops

The car shops of the Bangor & Aroostook at Houlton, Me., which normally employs between 30 and 40 men, has been leased to A. E. Astle, Houlton, Me., who will make repairs to cars on a contract basis. This action was taken because output had been unsatisfactory and the size of the shops did not warrant additional expense for supervision. The railroad estimates that the new arrangement will effect a saving to the company in labor costs of approximately 10 per cent.

Addition to M. D. T. Company's Shop

The Merchants' Dispatch Transportation Company is making extensive additions to its car shop at East Rochester, N. Y. Approximately 125,000 square feet of space is being provided for repairs to steel cars. The shop is to be of steel frame construction with steel sash and will be fitted with modern equipment for repairing or rebuilding steel freight cars. In addition a new blacksmith shop of 10,000 square feet floor area has recently been erected.

Annual Meeting American Railway Association

The annual meeting of the American Railway Association was held at the Waldorf-Astoria Hotel, New York, on Wednesday, November 16, with an attendance of about 200 and R. H. Aishton, president of the association, in the chair. The membership now includes 391 full members and 345 associate members, operating 314,019 miles of road. The board of directors reported that since the last meeting, a Safety Section had been created within the Operating Division; and that M. J. Gormley has been appointed chairman of the Car Service Division at Washington.

N. Y. C. Leases Shops

The New York Central has leased its car repair shops at East Buffalo, N. Y., to William J. Conners, a prominent business man of that city, and work was resumed this week after an almost complete suspension for about eight months. The lessee expects to employ from 1,500 to 2,000 men. The manager of the shops, under Mr. Conners, will be James J. Barrett. It is proposed to make the work-day ten hours.

It is understood that negotiations are pending for a similar disposal of the extensive shops at West Albany, N. Y.

It is reported that the shops at Collinwood, Ohio (Cleveland), and those at Air Line Junction, near Toledo, have been leased to the A. S. Hecker Company, of Cleveland.

Obsequies for Steam Locomotive Will Not Be Staged for Some Time

The Superpower Survey report was discussed by W. J. Cunningham, professor of transportation, Harvard University, in an article which appeared in the New York Evening Post, November 15. In commenting on the position of the steam locomotive, he said:

"From time to time, as certain railroads have changed from steam to electrical operation for portions of their lines, the passing of the steam locomotive has been confidently predicted by experts who have been impressed with the superiority of electric traction, but the steam locomotive not only appears to be holding its own, but by notable improvements in design and appurtenances seems recently to have taken a new lease of life."

The Freight Car Situation

The Car Service Division of the American Railway Association reported a total of 354,996 bad order freight cars on October 15, or 15.5 per cent as compared with 15.8 per cent on October 1. On November 1 this total showed another slight decrease, the total being 345,201 cars, or 15 per cent.

Surplus Serviceable Cars

The freight car surplus continued to decrease during the weeks ended October 15, October 23 and November 1. During these periods the totals reported by the Car Service Division of the American Railway Association were 121,944, 99,971 and 80,203 cars respectively.

Ben W. Hooper to Be Guest of the New York Railroad Club

Ben W. Hooper, a member of the public group of the Railroad Labor Board and former Governor of Tennessee, is to be the speaker and guest of honor at the third annual dinner of the New York Railroad Club, which will be held at the Commodore Hotel, New York, Friday evening, December 15. Mr. Hooper played a most important part in the recent wage controversy. Tickets for the dinner may be had by applying to W. J. Moody, treasurer, Erie Railroad, 50 Church street, New York City.

Car Loadings

The Car Service Division of the American Railway Association reported an increase of 10,294 cars during the week ended October 15 when the number of cars loaded with revenue freight totaled 906,034.

Another increase was noted in the total for the week ended October 22. During this period 962,292 cars were loaded, or 56,258 cars more than reported for the previous week.

For the week ended October 29, however, the cars loaded totaled 952,261, a decrease of 10,031 cars as compared with the total for the preceding week which was abnormal because of the strike threat.

During the week ended November 5, loading of revenue freight totaled 829,722 cars. This was a reduction of 122,899 cars when compared with the total for the previous week, 85,893 cars less when compared with the total for the corresponding week of 1920, and 2,998 cars more than were loaded during the corresponding week of 1919.

Germany Considering Denationalization of Railways

Brig.-General Sir Henry W. Thornton, general manager of the Great Eastern Railway, England, has recently returned from a trip to Germany and brings the information that whereas the Germans found it possible to operate the railways economically as a nationalized system under the monarchy, it has been found impossible under the present form of government to approach anywhere near the satisfactory results previously obtained. Serious consideration is therefore being given to turning the railways over to private interests for operation. Various press dispatches have indicated the likelihood of Hugo Stinnes, Germany's great industrial magnate, taking over the entire railway system.

Canadian Tank Cars for Soviet Russia

Five hundred tank cars built in Canada will immediately be placed on Canadian steamers for transportation to Novorossiisk, a Russian port on the Black Sea, according to a report from Consul Felix S. S. Johnson, at Kingston, Ontario. Four of the largest Canadian government freighters will be employed to carry the cars to Russia, and it is expected that final shipment will be made before the close of navigation.

The contract for the manufacture of the tank cars was secured through the Soviet Trade Commission, London, at a price of $2,000,000. The cars, which are being built to the Russian gage of five feet, will be used in Russia's extensive oil fields. A technical expert representing the Soviet government is now in Canada testing the completed cars, and as these are approved they are placed on board the two government ships which will carry the

first shipment to Russia. The remainder of the cars will follow aboard two other government vessels before the close of navigation.

Locomotive Orders

The Southern Pacific has ordered 50 Santa Fe type locomotives from the Baldwin Locomotive Works.

Freight Car Orders

The Central of New Jersey has ordered 125 50-ton coal cars and 85, 40-ton box cars from the Standard Steel Car Company.

The Alabama, Tennessee & Northern has given an order to the Mt. Vernon Car Manufacturing Company for 300 standard freight cars.

The Denver & Rio Grande has ordered 700 70-ton gondola cars, with an option of 300 additional, from the Pressed Steel Car Company.

The Pennsylvania Tank Line, Sharon, Pa., has ordered 200 tank cars of 10,000 gal. capacity from the Pennsylvania Tank Car Company.

The Chicago, Milwaukee & St. Paul has ordered 1,000 gondola cars of 50-ton capacity from the Bettendorf Company and 1,500 from the Haskell & Barker Car Company.

The Atchison, Topeka & Santa Fe has awarded a contract for 1,250 refrigerator cars to the American Car & Foundry Company and 1,250 of the same type to the Haskell & Barker Car Company.

The Illinois Central has awarded a contract for 350 40-ton refrigerator cars to the General American Car Company, and for 650 of the same type to the Haskell & Barker Car Company. Delivery is to be started by February 1, 1922, and is to be completed not later than March 10, 1922.

The Chicago, Burlington & Quincy, on November 7, authorized the expenditure of $15,000,000 for the purchase of 7,000 freight cars, 55 heavy freight and passenger locomotives and 127 all-steel passenger cars, to be used on the three lines operated by the company.

Contracts for Car Repairs

The Wabash has given a contract to the Western Steel Car & Foundry Company for the repair of 250 hopper cars.

The Erie will have repairs made to 100 50-ton steel coal cars at the shops of the Pennsylvania Tank Car Company.

The Chicago & Alton has awarded a contract for the repair of 200 gondola cars to the Mount Vernon Car Company, Mt. Vernon, Ill.

The Atchison, Topeka & Santa Fe has awarded a contract for the conversion of 50 box cars into cabooses to the American Car & Foundry Company.

The Chicago, Burlington & Quincy has given a contract to the Western Steel Car & Foundry Company for repair work on 300 of its gondola cars.

The Canadian National Railways have let contracts to the Canadian Car & Foundry Company and the Eastern Car Company for the repair of 3,000 box cars with wood underframes.

The Toledo & Ohio Central has entered into a contract with the Ralston Steel Car Company for the repair of about 360 cars, for this road and the Kanawha & Michigan. A contract has also been given by the Toledo & Ohio Central to the Hamilton Car Company, Newark, Ohio, for the repair of 200 box cars.

Shop Construction

Sewell Valley.—This company has placed an order for the erection of a shop building at Rainelle, W. Va., with the Truscon Steel Company, Youngstown, Ohio.

St. Louis-San Francisco.—This company has awarded a contract for the construction of a one-story machine shop, 103 ft. by 40 ft., at St. Louis, Mo., to the Globe Construction Company, St. Louis, Mo.

Missouri Pacific.—This company has awarded a contract for the construction of two brick car repair sheds, 46 ft. by 500 ft. at St. Louis, Mo., to Joseph E. Nelson & Sons, Chicago.

Chicago, Burlington & Quincy.—This company has awarded a contract to the Materne Manufacturing Company, St. Louis, for the installation of a heating and washout system in its new engine house at Centralia, Ills.

Missouri, Kansas & Texas.—This company has awarded a contract to T. L. Johnson, Sedalia, Mo., for the reconstruction of its reclamation plant at Parson, Kan., which was destroyed by fire on September 17, at an estimated loss of $85,000.

American Society for Steel Treating Meeting

At the meeting of the board of directors of the American Society for Steel Treating, held at Cleveland, Ohio, during the week of November 7, it was decided to hold two sectional meetings of the society during the coming year, one in New York during January or February, and the other in Pittsburgh, Pa., in May. These meetings, at which one or two well chosen, preprinted papers will be presented, will be of one or two days' duration and will be in addition to the annual convention and exposition which will be held at Detroit, Mich., September 25 to 30, 1922.

New Motive Power for the Railways of Mexico

The Baldwin Locomotive Works has recently completed a group of locomotives of various types for the railways of Mexico, which are of interest not only from an engineering standpoint but also because their construction represents an important item in the plans now being carried out for the rehabilitation of these lines. The locomotives referred to include 83 for the National Railways of Mexico and 11 for the Mexican Railway, besides a number of others built for industrial companies.

The locomotives for the National Railways are of three types: 20 Pacific (4-6-2) for passenger service, 23 Mikados (2-8-2) for heavy freight service and 40 Consolidations (2-8-0) for lighter freight service. These locomotives all use a heavy grade of Mexican oil for fuel, and are of standard gage with the exception of 20 of the Consolidations, which are 3 ft. gage.

Anthracite Shipments—October, 1921

The shipments of anthracite for October, as reported to the Anthracite Bureau of Information, Philadelphia, amount to 5,872,753 tons against 5,519,412 for the preceding month of September, an increase of 353,371 tons, but show a decrease over October of last year of 368,118 tons, when 6,240,901 tons were recorded. October of this year can be considered a fair average shipment when consideration is given to the fact that a number of mines in the Scranton district were idle during the month owing to the fact that they could not operate under the provisions of the Kohler Act. Operations at these mines were resumed, however, on November 2. The total shipments for the coal year beginning April 1 have amounted to 40,223,367 tons but as compared with 39,720,654 tons for the corresponding period last year, a gain of 502,713 tons.

Central Europe's Roads Need Fuel and Equipment

The railway lines of what was formerly the Austro-Hungarian empire are all intact and are in the main in excellent physical condition, but normal traffic will never be resumed until the new states which were formed out of the former Austro-Hungarian empire are willing to co-ordinate their resources and facilities. Naturally there is a shortage of rolling stock, both motive power and cars, but, for the present, it would not be necessary to build a single new locomotive or a single new car if the bad order locomotives and cars which have been standing around for three years were repaired and put in service. It is not necessary to state that these bad order locomotives and cars could be available for service at a fraction of the cost of purchasing new equipment.

In 1919 and the first half of 1920 shortage of coal was a bad handicap to railroad operation in all the succession states. During the past six months there has been a considerable in-

crease in coal production, or at least in the allocation of coal for transportation purposes, and now the principal trouble is shortage of locomotives and cars.

Polish Government Places Order for Locomotives and Cars

The Polish ministry of railways has placed orders with Polish firms for 2,970 locomotives, 7,800 passenger coaches, and 70,000 freight cars, according to a report published in the Warsaw Polish Courier and transmitted to Commerce Reports by Consul General L. J. Keena of Warsaw.

The orders were distributed as follows: First Locomotive Construction Company, Chrzanow, 1,200 locomotives; Locomotive Construction Company, Warsaw, 360 locomotives; H. Cegielski Company, Fosen, 1,410 locomotives and 4,400 coaches and freight cars; Wagon Car Factory, Ostrow, 2,800 coaches and 18,000 freight cars; Lipop, Rau and Loewenstein, Warsaw, 3,000 coaches and 20,000 freight cars; Boiler Manufacturing Company Ostrowiec, 20,000 freight cars.

The contracts for locomotives run to 1932, and the contracts for passenger coaches and freight cars to 1922. Nearly 200 locomotives are to be delivered during the first two years.

C. S. Gaskill Joins Russian Mission of American Relief Administration

Charles S. Gaskill, formerly master mechanic of the Pennsylvania at Baltimore, sailed on October 4 to join the staff of Colonel W. N. Haskell, director of the American Relief Administration's Mission to Russia. Mr. Gaskill will have charge of the transportation of the foodstuffs with which the Administration proposes to supply the Russians. Mr. Gaskill was born at Mount Holly, N. J., on October 11, 1877. He was graduated from Princeton in 1898 and entered the employ of the mechanical department of the Pennsylvania at its Altoona shops. In 1917 he left his position as master mechanic at Baltimore to join the Railway engineers of the A. E. F. He was commissioned major and, later, lieutenant colonel. Following his discharge from the army, Mr. Gaskill became technical adviser to the Polish Ministry of Railways and held that position until quite recently when, having returned to this country to take up railway work again, he received his appointment to serve under Colonel Haskell.

C. S. Gaskill

Annual Dinner of Central Railway Club

The Central Railway Club held its annual dinner at the Hotel Iroquois, Buffalo, N. Y., on the evening of November 10. About 300 railroad men and guests attended, a large number coming from other cities, including a delegation in two special cars from New York. W. H. Flynn, superintendent of motive power of the Michigan Central and president of the club, introduced Hon. Charles F. Moore, who acted as toastmaster. At the conclusion of the dinner Arthur T. Baldwin, vice-president of the McGraw-Hill Company, delivered an address.

Frank C. Pickard, a former president of the club, was presented with a testimonial in recognition of his work for the organization, the presentation being made by W. F. Jones, also a past president.

Announcement was made of the election of the following officers to serve for next year: President, George Thibaut, master mechanic, Erie railroad; first vice-president, W. O. Thompson, general superintendent rolling stock, New York Central; second vice-president, J. R. Schrader, general car foreman, New York Central; third vice-president, C. L. McIlvaine, superintendent motive power, Pennsylvania, Central region. Members of executive committee; A. N. Dugan, Bronze Metal Company; J. M. Gaiser, Erie, and T. J. O'Donnell, chief joint inspector, Buffalo.

Rumored Pullman and Haskell & Barker Will Combine

The final details of the rumored merging of the Pullman Company and the Haskell & Barker Car Company, it is reported, were agreed on by committees representing both companies at Chicago on November 14. These committees are expected to report to their respective directorates within a short time, and it is expected that the directors will then call for a special meeting to vote approval of the plan, which provides for the giving of 3 shares of the stock of the Pullman Company in exchange for 4 shares of Haskell & Barker.

It is also reported that John S. Runnels, president of the Pullman Company, is to become chairman of the board of directors of the new company and Edward F. Carry, president of Haskell & Barker, is to become president. The merger would bring together the Pullman Company, with a capitalization of $173,000,000, and with plants at Pullman, Ill.; St. Louis, Mo.; Wilmington, Del.; Buffalo, N. Y., and Richmond Cal., and, with a capitalizataion of $36,000,000, the Haskell & Barker Car Company, with a plant at Michigan City, Ind., with an annual capacity of 22,500 freight cars.

MEETINGS AND CONVENTIONS

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILWAY ASSOCIATION, DIVISION V—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next annual convention June 14 to 21, 1922, Atlantic City, N. J.

DIVISION V—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION VI.—PURCHASES AND STORES.—J. P. Murphy, N. Y. C., Collinwood, Ohio.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa. Annual meeting Atlantic City, June, 1922.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Annual meeting December 5 to 9.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention and exposition September 25 to 30, 1922, Detroit, Mich.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Regular meeting second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, New Morrison Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings first Tuesday in month except June, July and August, at the American Hotel Annex, St. Louis, Mo.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Meeting second Thursday in January, March, May, August and November, Hotel Iroquois, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meeting second Tuesday, February, May, September and November.

DIXIE AIR BRAKE CLUB.—E. F. O'Connor, 10 West Grace St., Richmond, Va.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill. Next annual meeting May, 1922, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.

MASTER BOILERMAKER ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next annual convention Hotel Sherman, Chicago, May 23 to 26, 1922.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting December 13. Paper on Rebuilding Old Locomotives will be presented by C. B. Smith, mechanical engineer, Boston & Maine.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Third annual dinner December 15.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Meeting second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meetings fourth Thursday in each month, except June, July and August, at Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Meeting second Friday of each month, except June, July and August.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, Marine Trust building, Buffalo, N. Y.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 14 E. Jackson Boulevard, Chicago. Regular meetings third Monday in each month, except June, July and August.

PERSONAL MENTION

GENERAL

O. S. Jackson has been appointed assistant superintendent of motive power of the Union Pacific, with headquarters at Omaha, Neb.

M. B. McPartland has been appointed superintendent of motive power of the Western Pacific with headquarters at Sacramento, California, and the position of general master mechanic has been abolished.

E. E. Machovec, master mechanic of the Atchison, Topeka & Santa Fe, with headquarters at Argentine, Kan., has been promoted to acting mechanical superintendent of the Northern Lines, Western District, with headquarters at La Junta, Colo., succeeding J. R. Sexton, who has been granted an indefinite leave of absence due to ill health.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

J. E. Carr has been appointed assistant general road foreman of engines of the United Railways of Havana, with headquarters at Cruces, Cuba.

M. C. M. Hatch has been appointed mechanical engineer of the Missouri, Kansas & Texas, with headquarters at Parsons, Kan., succeeding W. H. Maddocks, retired. Mr. Hatch was born at Chelsea, Mass., on March 14, 1882. After two years' attendance at the Massachusetts Institute of Technology, and two years at the University of California, he entered railroad service in June, 1903, working in the Southern Pacific shops at West Oakland, Cal., and in the testing and signal departments for about 18 months and about six months in the Atchison, Topeka & Santa Fe shops at Needles, Cal., and San Bernardino. In June, 1905, he became a draftsman in the motive power department of the Boston & Maine, and in December, 1906, he was promoted to chief draftsman of that road, which position he held until November, 1911, when he was appointed engineer of tests of the New England Lines. In June, 1912, he was appointed superintendent of locomotive fuel service of the Delaware, Lackawanna & Western, which position he resigned in February, 1917, to become assistant to the president of the Locomotive Pulverized Fuel Company. He held this position until January, 1920, when he left this company to become a representative of the Railway & Industrial Engineers. He reentered railroad service in April, 1921, as assistant mechanical engineer of the Missouri, Kansas & Texas, with headquarters at Parsons, Kan., which position he was holding at the time of his recent promotion.

M. C. M. Hatch

J. W. Keppel, general foreman of the Canadian Pacific, with headquarters at Vancouver, B. C., has been promoted to master mechanic of the Regina division, Saskatchewan district, with headquarters at Regina, Sask., succeeding W. G. McPherson.

F. M. Mozley, roundhouse foreman of the Gulf, Colorado & Santa Fe at Gainesville, Tex., has been appointed master mechanic of the Southern division with headquarters at Temple, Tex.

SHOP AND ENGINEHOUSE

J. Gibson, master mechanic of the Canadian Pacific, with headquarters at Moose Jaw, Sask., has been appointed general foreman, with headquarters at Revelstock, B. C. W. G. McPherson, master mechanic, with headquarters at Regina, Sask., succeeds Mr. Gibson at Moose Jaw.

J. McKenzie has been appointed shop superintendent of the Pere Marquette at Ionia, Mich., succeeding J. Speckin, assigned to other duties. W. F. Crowder has succeeded Mr. McKenzie as general car inspector.

A. H. Powell has been appointed superintendent of the Jeffery shops of the Western Pacific, with headquarters at Sacramento, California.

PURCHASING AND STORES

C. W. Dearworth has been appointed division storekeeper of the Erie with headquarters at Huntington, Ind., and R. H. Pauling has been appointed to a similar position with headquarters at Marion, Ohio.

B. T. Jellison, general purchasing agent of the Chesapeake & Ohio, has been appointed special agent, handling special matters assigned, and the position of general purchasing agent has been abolished.

A. Ross has been appointed division storekeeper of the Erie with headquarters at Jersey City, N. J., and M. H. Keyes has been appointed to a similar position with headquarters at Buffalo, N. Y.

J. M. Velasco, assistant general purchasing agent of the National Railways of Mexico, with headquarters at New York, has been appointed purchasing agent with headquarters at Mexico City. W. L. Wibel succeeds Mr. Velasco at New York.

OBITUARY

Axel S. Vogt, formerly mechanical engineer of the Pennsylvania, died on November 11 of heart failure.

James D. Collinson, formerly general master mechanic of the Atchison, Topeka & Santa Fe, died at his home in Houston, Tex., on November 9. Mr. Collinson was born in Manchester, England, on January 21, 1849. He first entered railroad service in the mechanical department of the Chicago, Milwaukee & St. Paul. In 1889 he left to become general foreman of the shops of the Atchison, Topeka & Santa Fe at Topeka, Kan., and was thereafter promoted to master mechanic at Raton, N. M., being later transferred to Fort Madison, Iowa. He became superintendent of motive power of the Gulf, Colorado & Santa Fe in 1896, assistant superintendent of motive power of the main line, with headquarters at Topeka, in 1900, and general master mechanic in 1901, during which year he retired from railroad service.

Charles E. Oakes, superintendent of shops of the Kansas City Southern at Pittsburgh, Kans., died on October 13. Mr. Oakes was born January 4, 1880, at Danville, Ill., and entered railroad work at the age of sixteen, his first position being with the Chicago & Eastern Illinois at Danville where he served an apprenticeship to the boilermaker's trade. He was then transferred to the drafting room where he worked his way up to assistant chief draftsman. In October, 1910, he resigned this position to become chief draftsman for the Kansas City Southern with headquarters at Pittsburgh, Kans. This position he held for 11 months, resigning to become chief draftsman of the Missouri Pacific at St. Louis, Mo. On April 16, 1914, he returned to the Kansas City Southern as mechanical engineer; in May, 1919, became general agent for the Peoria Life Insurance Company and on October 1, 1920, superintendent of shops of the Kansas City Southern.

Charles E. Oakes

SUPPLY TRADE NOTES

W. F. Abel has been appointed assistant general manager of sales of the Electric Alloy Steel Company, Youngstown, Ohio.

Walter E. Heibel has accepted a position as sales engineer of the B. F. Sturtevant Company, Boston, Mass., with headquarters in New York.

Walter C. Carroll, assistant general sales manager of the American Sheet & Tin Plate Company at Pittsburgh, Pa., has been appointed vice-president of the Inland Steel Company, Chicago.

Ben L. Whitney, formerly with the Byers Company, has opened an office at 528 Detroit Savings Bank building, Detroit, Mich., and will represent the Orten & Steinbrenner Company in that territory.

Press G. Kennett, formerly representative of the Flint Varnish & Color Works, with headquarters at St. Louis, Mo., in charge of sales in the south and southwest, has been appointed manager of the railway sales of the Chicago Varnish Works, with headquarters at Chicago. Mr. Kennett has been with the Flint Varnish & Color Works for the past 12 years, and when the Du Pont interests took over the company he was appointed representative at St. Louis. Prior to going with the Flint concern, he was connected with the purchasing and supply departments of several railroads in the south and southwest, serving as general storekeeper for the Illinois Southern in 1905 and in the same capacity for the Southern Indiana in 1906 and 1907.

Press G. Kennett

W. H. Snedeker, formerly in the Tacoma, Wash., office of the Griffin Wheel Company, Chicago, has been appointed manager of sales at the office established by the company in the Rialto building, San Francisco, Cal.

G. H. Jones, vice-president and one of the founders of the Inland Steel Company, Chicago, will retire from active service in the company about Jan. 1, 1922. Mr. Jones will retain his interest in the company and will continue as a director and a member of the executive committee.

The United States Cast Iron Pipe & Foundry Company, Burlington, N. J., has opened a new office at 811 Dixie Terminal building, Cincinnati, Ohio. P. T. Laws, assistant works manager, now has his headquarters at the new office and Harold G. Henderson is in charge of sales from this office.

C. H. Hobbs has been appointed assistant general manager of sales of the Detroit Seamless Steel Tube Company of Detroit, Michigan. Mr. Hobbs was in the service of the Lackawanna Steel Company for over 14 years and for the last five years was district representative in charge of its Detroit office.

The H. K. Ferguson Company, Cleveland, Ohio, has arranged with the Morgan Engineering Company, Alliance, Ohio, to design and build gap cranes for locomotive lift-over service. In return the Morgan Engineering Company has made the H. K. Ferguson Company its sales representative in the railway field.

The Virginia Car Corporation, Alexandria, Va., has been organized in Virginia with a capital of $100,000. The officers are E. A. Morse, president, Washington, D. C.; L. D. Christie, treasurer, Alexandria, Va.; S. A. Aplin, secretary, Washington The company will build and repair railroad cars and will lease part of the Virginia Shipbuilding Corporation's plant at Alexandria.

Frank P. Smith for over 20 years identified with the Hancock Inspirator Company, sales department of Manning, Maxwell & Moore, Inc., New York, died on November 3, at his home at Manhattan Beach, N. Y., at the age of 66 years. Mr Smith was in railroad service previous to entering the railway supply field.

M. E. Gregg has been appointed district sales manager for the Lackawanna Steel Company at Detroit, Mich., succeeding C. H. Hobbs. Mr. Gregg has been connected with the general sales department of the Lackawanna for the past two years, prior to which time he was Buffalo district manager for the Republic Iron & Steel Company.

William Bosworth has resigned his position as assistant engineer in charge of contracts and production with the Underfeed Stoker Company of America, Detroit, Mich., to accept the position of mechanical engineer with the Wine Railway Appliance Company, Toledo, Ohio. Mr. Bosworth's experience has been almost entirely railway mechanical engineering. He had been mechanical engineer on several steam railroads prior to three and a half years ago when he became associated with the Underfeed Stoker Company.

The Reilly-Peabody Fuel Company, Pittsburgh, Pa., announces a change in name to Peabody Fuel Company with the following officers: F. E. Peabody, president; R. E. Peabody, vice-president; W. Russell Carr, vice-president; C. M. Rhoads, secretary and treasurer, and T. J. Atchison, general sales manager. All these also are officers of the American Coke Corporation, with the same titles. F. E. Peabody has resigned as treasurer of the Eastern Fuel Company and severed all his connection with that company and its subsidiary, the Georges Creek Coal Mining Company.

James Brown Rider, vice-president and general manager of the Pressed Steel Car Company and the Western Steel Car & Foundry Company, with headquarters at Pittsburgh, Pa., died on November 2, at Pittsburgh, Pa., after an illness of four months. Mr. Rider was born at Morrison's Cove, Blair County, Pa., on September 10, 1879. He entered the service of the Pennsylvania Railroad in 1895, and remained with it until 1899, acting successively as messenger boy, shop order clerk, invoice clerk and stenographer. In 1899 he became connected with the Pressed Steel Car Company as stenographer and clerk to the general manager, being advanced to the position of assistant to the vice-president in July, 1905. He was appointed general manager in July, 1909, and made a member of the board of directors in January, 1913. Mr. Rider was appointed general manager of the Western Steel Car & Foundry Company in August, 1913, and in December, 1915, he was elected a vice-president of the Pressed Steel Car Company and Western Steel Car & Foundry Company, with headquarters at Pittsburgh; he continued to perform the duties of general manager in charge of operations. He was also vice-president of the American Steel Company of Cuba.

James B. Rider

F. L. Kellogg, manager of the New York branch at 25 West Forty-third street, New York City, of the Electric Storage Battery Co., Philadelphia, Pa., has been appointed district manager of the North Atlantic district, with headquarters at 25 West Forty-third street, New York. F. F. Sampson, manager

of the Exide depots and garages, succeeds Mr. Kellogg as manager of the New York branch, with D. P. Orcutt as assistant manager. The entire sales organization in New York City was recently consolidated and Mr. Sampson was appointed manager and Mr. Orcutt assistant manager.

Henry P. Hoffstot has been elected vice-president of the Pressed Steel Car Company in addition to his duties as president of the Koppel Industrial Car & Equipment Company. He was formerly manager of sales, central district, of the Pressed Steel Car Company before assuming duties as president of the Koppel Company. C. W. Wrenshall, general superintendent and acting general manager, has been appointed general manager of the Pressed Steel Car Company, and W. A. Chamberlain, formerly auditor, has been appointed comptroller, all with headquarters at Pittsburgh, Pa. C. E. Church, secretary and assistant treasurer, has been appointed secretary and treasurer with office at New York.

The J. G. Brill Company, Philadelphia, Pa., announces the formation of a new company, the Canadian Brill Company, Ltd., organized to build and sell electric and steam railway rolling stock in the Dominion of Canada. The new company has taken over the plant and equipment of the Preston Car & Coach Company, Ltd., Preston, Ontario, and has a number of orders now in process of construction. This plant is a modern car shop, having 11½ acres of ground located on the outskirts of the city. The executives of the new company are: Samuel M. Curwen, president; H. K. Hauck, first vice-president; Alfred Clare, second vice-president; H. D. Scully, general manager and secretary, and E. P. Rawle, treasurer.

Robert A. Ogle, president of the Ogle Construction Company, died on November 2. Mr. Ogle was born at Spalding Springs, Mo., on November 16, 1865. He was engaged in general building contracting at Monroe City, Mo., until 1898, when he organized and became director of the Safety Fund Life Association, subsequently the Missouri State Life Insurance Company. In 1903 he became affiliated with an engineering and construction company at St. Louis, Mo., specializing in the railroad construction field. He left that company in 1906 to enter the service of the Otto Gas Engine Works with headquarters in Chicago. While with this company he was mostly engaged in water service and coaling station construction. In 1911 he organized the Ogle Construction Company at Chicago, and since that time he has been actively identified with the development of coaling station construction and equipment.

Robert A. Ogle

W. H. Rastall has been appointed chief of the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce and in this position will have charge of the government's activities in furthering American foreign trade in railway equipment and supplies. Mr. Rastall was born in 1879. He was educated in the public schools of Chicago, the Hebron Academy (Maine), the University of Maine and Cornell University, from which institution he was graduated in 1904. Before completing his education, Mr. Rastall served as a draftsman for the Latrobe Steel & Coupler Company, Melrose Park, Ill., and for several shipbuilding companies. From 1904 to 1911 he was resident engineer of the American Trading Company at Kobe, Japan. From 1913 to 1917 he was sales engineer for the Worthington Pump & Machinery Corporation. In the latter year he entered the service of the Bureau of Aircraft Production as an aeronautical mechanical engineer. In October, 1918, he left this position to investigate the markets for American industrial machinery in the Far East in behalf of the Department of Commerce. He was occupied on this mission, until the summer of this year, when he returned to this country to take up his new duties.

TRADE PUBLICATIONS

Drill Chucks.—A series of circulars featuring several types of drill chucks has recently been issued by E. Horton & Son Company, Windsor Locks, Conn.

Belt and Motor-Driven Hammers.—Beaudry & Co., Boston, Mass., has recently issued a 12-page booklet describing and illustrating its Champion type power hammers.

Stokers.—A four-page, colored folder illustrating and outlining the advantages of the Jones automatic cleaning stoker has recently been issued by the Under-Feed Stoker Company, Detroit, Mich.

Chucks.—The Skinner Chuck Company, New Britain, Conn., has recently issued Catalogue No. 35, which is a useful, illustrated source of information on its line of lathe, drill and planer chucks and vises.

High Speed Metal Saws.—The Peerless Machine Company, Racine, Wis., has recently issued a circular containing a complete revision of list prices of its line of high speed metal saws. These prices mark a return to the 1918 basis.

Fuel Oil Engines.—The Hatfield-Penfield Steel Company, Bucyrus, Ohio, has issued two catalogues describing and illustrating its Diesel type vertical and horizontal standard fuel oil engines which are built in two and three cylinder sizes, respectively.

Hydraulic Power Transmissons.—The Oilgear Company, Milwaukee, Wis., has issued a booklet composed of several bulletins which describe and illustrate the variable speed oil-pressure power transmission machinery recently exhibited at Chicago.

Cranes.—Catalogue No. 158, superseding No. 151, has recently been issued by the Whiting Corporation, Harvey, Ill., describing and illustrating its standard crane designs. Several tables of standard clearances and a brief outline of the company's facilities for building cranes are also included.

Valves.—The Pratt & Cady Company, Hartford, Conn., has recently issued Catalogue No. 6 listing its complete line of brass and iron body valves and asbestos packed cocks. This catalogue, which supersedes all previous issues, is a book of 161 pages and contains illustrations, drilling tables, drilling list prices, etc.

Vacuum Pumps.—Several new features of design are incorporated in the line of dry vacuum pumps presented in Bulletin No. 710, which the Chicago Pneumatic Tool Company, New York, has recently issued. The pumps described and illustrated are of the steam, belt and motor driven types and are particularly suited for service in power plants, gasoline extraction plants, chemical works, sugar houses, canneries, etc.

Pumps.—The Sullivan Machinery Company, Chicago, Ill., has recently issued three new bulletins, Nos. 71-G, 71-F and 70-W, describing in detail, in pictures and in diagrams the construction and operation of its air lift pumps, displacement pneumatic pumps and rotator hammer drills. The pneumatic pumps are an entirely new line intended primarily for handling acid, but are also used for pumping any liquid when local conditions make this form of pump desirable.

Radial Wall Drill.—The Pawling & Harnischfeger Company, Milwaukee, Wis., has recently issued Bulletin No. 206 describing its No. 6 radial wall drill which has been designed to meet the demand for a simple and effective machine for drilling, reaming and countersinking large unwieldy pieces. Examples of interior and exterior drilling of large steel drums and the drilling and reaming of structural material are shown in the bulletin, also dimension drawings.

Self-Opening Die Heads.—The different styles of H & G die heads are pictured and described in detail in a simple manner in a new catalogue of 93 pages, recently issued by the Eastern Machine Screw Corporation, New Haven, Conn. Much valuable data which should be useful to the man working out threading problems has been compiled and included in this unusual catalogue, also a number of illustrations showing the die heads installed on lathe and screw machines.

BUYERS INDEX

For location of advertisements of manufacturers listed in the Buyers Index, see Alphabetical Index on the last page next to cover

Carbon Tool Steel—(See Steel, Alloy and Carbon).

Car Door Fasteners.
National Malleable Castings Co.

Car Floats.
American Car & Fdry. Co.

Car Jacks—(See Jacks).

Car Lighting.
General Electric Co.

Car Step Heads—(See Step Heads).
Universal Safety Tread Co.

Car Wheel Grinding Machines—(See Grinding Machines, Car Wheel).

Cars, Motor.
General Electric Co.

Cars, Railroad.
American Car & Fdry. Co.

Cast Iron Welding Rods—(See Welding Rods).

Cast Steel Welding Rods—(See Welding Rods).

Castings, Brass and Bronze.
Allan & Son, A.
Gilbert & Sons Brass Fdry. Co., A.

Castings, Electric Steel.
Pelton Steel Co.

Castings, Gray Iron.
American Car & Fdry. Co.
Hilles & Jones Co.

Castings, Iron and Steel.
Commonwealth Steel Co.
McConway & Torley Co., The.
National Malleable Castings Co.

Castings, Malleable.
American Malleable Castings Association.
National Malleable Castings Co.

Castings, Steel.
American Steel Foundries Co.
Commonwealth Steel Co.
McConway & Torley Co., The.
Modern Steel Casting Co.

Cement, Iron.
Smooth-On Mfg. Co.

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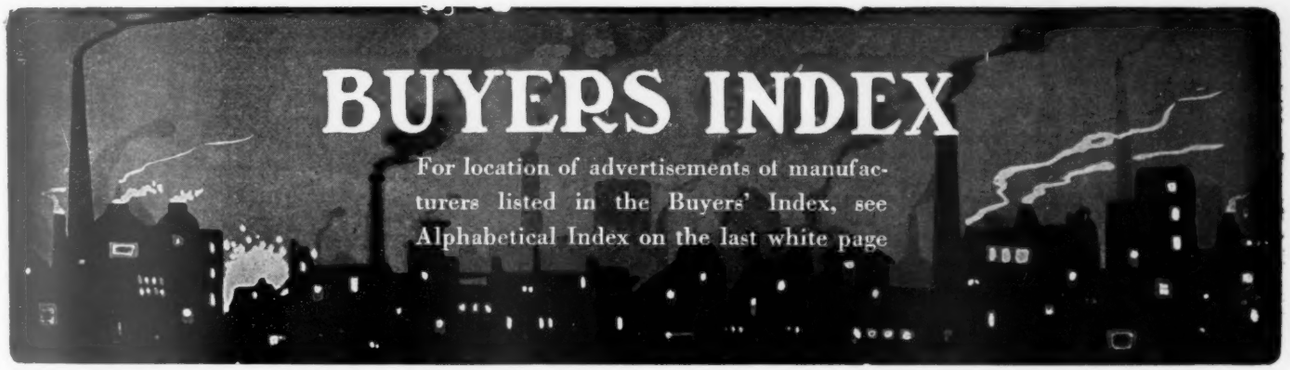

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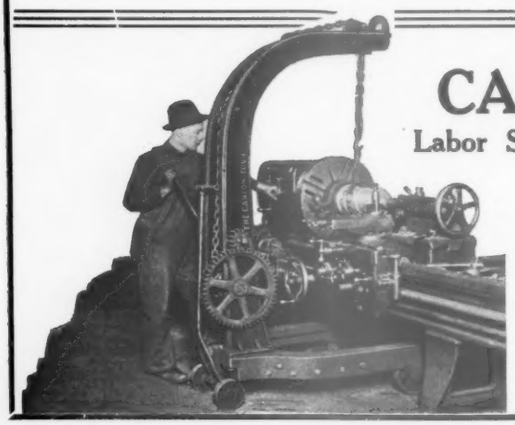

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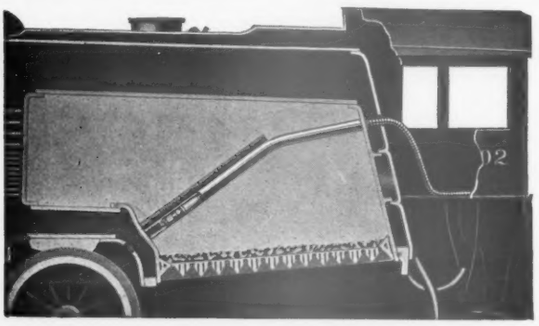

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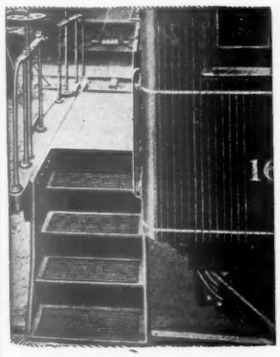

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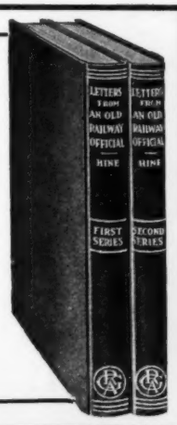

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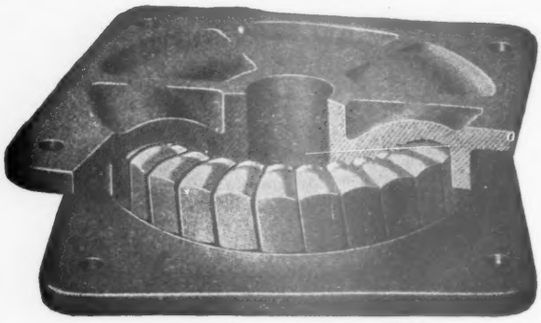

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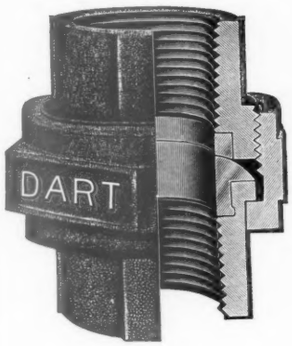

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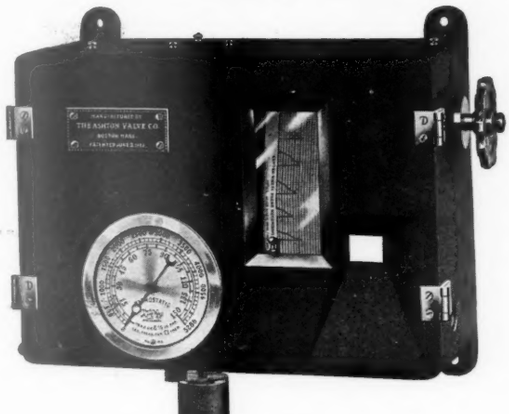
Gem Manufacturing Co.
PITTSBURGH, PA.

Ashton Wheel Press Recording Gages



Ashton Wheel Press Recording Gages give an accurate record of wheel fits on axles, showing actual fit from start to finish, insuring perfect mountings.

Send for special circular which gives full details, also catalogue describing our complete line of Specialties.

The Ashton Valve Co.

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DeVilbiss
Spray-painting System

Every Painting Job

DONE faster—better—at less cost

The average speed of painting with the DeVilbiss Spray-painting System is four or five times that of the hand-brush method.

This is not a one-day but an every-day average.

At the same time a more thorough, more permanent coating is applied. Every bit of surface that should be painted is properly coated with the spray.

Practically no more paint is required than with the hand-brush. Nor is it necessary to change paints.

The DeVilbiss outfit is easy, convenient and clean to operate. This results in more satisfactory working conditions and in the work being kept up to highest standard.

Whether painting a car body and trucks or a locomotive or a stencil, the savings and advantages are substantially the same.

Full particulars will be gladly submitted. They will prove interesting and profitable to have.

The DeVilbiss Mfg. Co.

3694 Detroit Ave.

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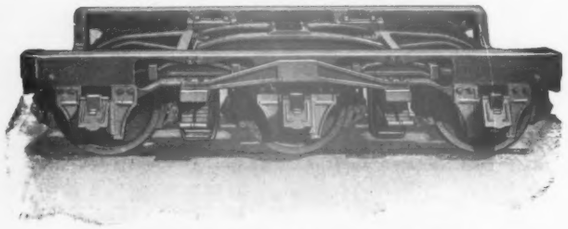

Top Equalizer Truck—Clasp Brakes

Bottom Equalizer—Truck—Four Wheel

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Commonwealth Passenger Trucks

(Patented)

Eliminate hundreds of pieces and greatly reduce maintenance and operating expense.

They provide great strength with flexibility,

Perfect alignment of pedestals,

Accurately spaced pedestal bolt holes,

Even wear of pedestals, boxes, journals, etc.,

And ease of inspection.

Either type designed for ordinary or clasp brakes.

The frames are planed and machined so they are absolutely square; and remain so.

They have a magnificent record of efficient, long and economical service on thousands of cars.

They provide the best known construction for firmly securing the axle generator.

They are strong, light, simple and durable.

Note the wonderful facility for obtaining any contour of cross members for clearance, without sacrificing strength; and for making the frame members wide or narrow to secure uniform stresses.

Commonwealth Steel Company

PIERCE BUILDING SAINT LOUIS

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QUALITY MS C SERVICE

STEEL CASTINGS

MODERN STEEL CASTING CO.

QUALITY MS C SERVICE

MILWAUKEE, WIS.

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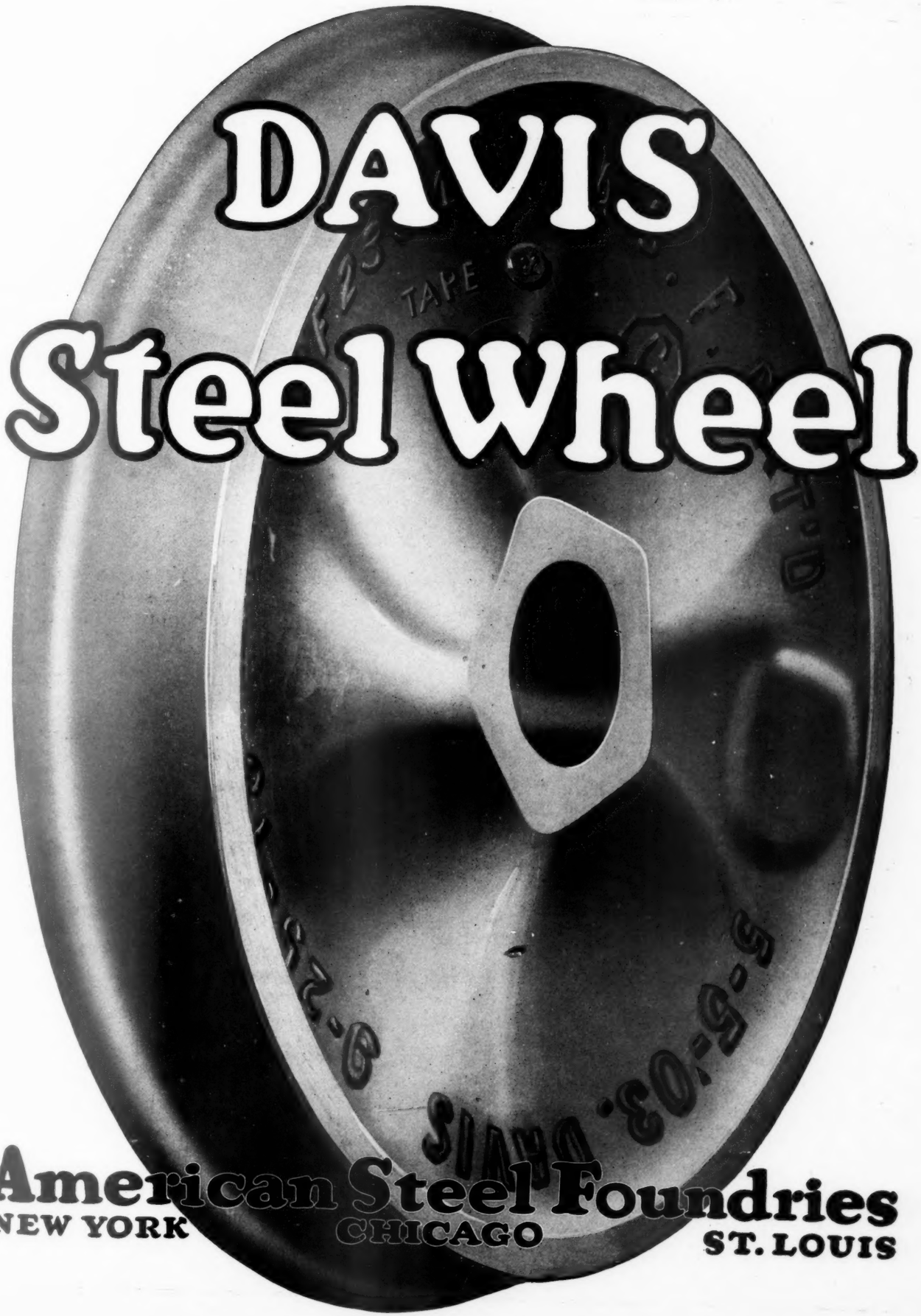
DAVIS
Steel Wheel
American Steel Foundries
NEW YORK
CHICAGO
ST. LOUIS

Good Teamwork Here

This picture would be more spectacular with one more figure included—a heater-boy at some distance, throwing hot rivets from a smoking forge to the sticker-boy in the foreground.

There would be more "action" in such a picture, but less work—and one more name on the payroll.

As it is, with the Berwick Electric Rivet Heater on the job, the heater-boy helps the riveter and backer-up in addition to tending the heater.

He can see the rivets being heated—hence every rivet goes in at the right temperature for easy driving and maximum tightness.

For the same reason there is no waste of rivets through burning and scaling.

Nor is there any discomfort to any of the workers in having the heater so conveniently close—no excessive radiation of heat, no smoke or fumes, no dirt.

Representative Users of the Berwick Electric Rivet Heater

The American Locomotive Company	20 heaters
National Steel Car Company	23 heaters
Hydraulic Pressed Steel Company	15 heaters
Virginia Bridge and Iron Company	11 heaters
Pressed Steel Car Company	26 heaters
Brown Hoisting Machinery Company	10 heaters
Brooklyn Navy Yard	21 heaters
Bethlehem Steel Company	12 heaters
Canadian Car and Foundry Company	55 heaters
American Car and Foundry Company	257 heaters
Magor Car Company	10 heaters
Philadelphia Navy Yard	22 heaters

The Berwick Heater illustrated is one of nine standard types and sizes for various requirements. Send for catalogue. Please mention number and sizes of rivets used and alternating current conditions.

American Car and Foundry Company

New York, 165 Broadway — Chicago, Railway Exchange Building — St. Louis, 915 Olive Street

BERWICK ELECTRIC RIVET HEATER

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